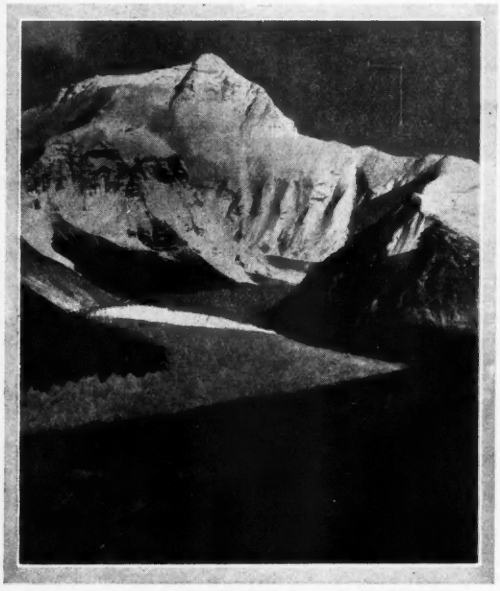
DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XIV. No. 163. JULY, 1933 PRICE 1s. NET



SHALL WE CONQUER EVEREST?
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Notes of the Month.

The annual reports of official bodies engaged in research are distinguished for a certain unenlightening verisimilitude. With notable exceptions, scientists are a secretive class, and only in America, it would seem, do scientific institutions find it proper to explain in language which is intelligible how the public money is being spent. The illustrated bulletins issued periodically by the Carnegie Institution of Washington are a model which might well be adopted in this country. £300,000 has been spent on research by the Empire Marketing Board during the past year. The cold official language of its annual report does small justice to the many important investigations carried on throughout the Empire, which might, with a little trouble, be made immensely interesting to the general reader. The report states that new research on tea is being carried out in India, "where the relevant facts about leaf production have been collected for the benefit of the industry," and that the study of tobacco is proceeding in Southern Rhodesia. Advantage might well have been taken of the annual report to explain the nature of these two branches of research, since a bald statement that investigations are proceeding is of little public interest. We are glad to learn more of the joint programmes of research which the Board initiated two years ago, when it invited suggestions for future investigations from various parts of the Empire. Proposals from India relate to the study of fruit transport problems, and of cotton breeding and wool research. The Colonial Advisory Council recommends the study of virus diseases in tropical crops and of the skin diseases which reduce the economic value of hides and skins produced in the Colonies—both problems of vital importance.

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In connexion with research in the Empire overseas, we may call attention to the articles which have been contributed to *Discovery* in recent months by scientists in the Dominions. Much research of the first importance is quietly carried on in the Empire universities and research institutes of which few reports appear in this country. Articles so far published in this journal have dealt with the study of the Australian aboriginal, wool research in New Zealand, the search for the remains of dinosaurs in the Red Deer Valley, Alberta, and the development of water power in Canada. The co-operation of readers is invited in expanding this series in future issues. It is not proposed to confine the articles to the work of official bodies, and the Editor would be glad to hear from any who may have interests in the Empire overseas or personal studies and experiences to describe.

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It is a far cry from the Maori's flaxen mat or fishing line to motor-fuel or silk-knit underwear, but these and other equally interesting results are being obtained by a new process for treating New Zealand flax, which has lately been perfected at a laboratory in Auckland. To some extent resembling Mercer's forty-year-old method of imparting to cotton fibre the softness and lustre of silk, and similar also to the more recently invented means of extracting cellulose from wood fibre, the new process is altogether different from that of the flax-miller whose object is to secure a firm fibre for yarn and other weaving purposes. The dried flax leaves are first finely chopped in a chaff-cutting machine, and next cooked in a digestor to obtain individual fibres. The remaining material, after drying in an oven, is bleached by being passed through oxygen. Treated with sulphuric acid, it is changed into a viscous amber-coloured liquid which, on exposure to the air, turns white and forms a cellulose

filament. This, as it becomes firmer, can be wound on a spool and later twisted into yarn—a modern adaption of the silkworm and spider's instinctive art. When dyed this yarn has the lustre of silk, and can be used in the manufacture of silk-knit underwear and similar essentials of modern fashion. Another product from the new process is alcohol, which, mixed with benzoin, provides an efficient fuel for internal combustion engines.

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A large part of the original collection of Africana, made by Mr. J. G. Gubbins, a well-known farmer in the Transvaal, and housed in the University of the Witwatersrand, was lost in the disastrous fire at the university on Christmas Eve, 1931, when the library, containing some 40,000 books, was destroyed. Mr. Gubbins promptly came to England and visited other countries in order to build up a new collection, and the success of his efforts may be judged from the exhibition now being held at South Africa House, London. Here a selection of the material is on view before being sent out to the university. The varied history of South Africa is vividly illustrated. Books are on view recording the early voyages of the Portuguese and other adventurers, whose southward expeditions in search of a sea-route to India led to the discovery of the Cape of Good Hope. The primitive life of the natives is well illustrated in the pictures of Thomas Baines, the explorer and gold seeker. His sketch of the Victoria Falls, probably the first ever made, bears the artist's note: "Sketched very hastily on account of the spray." Johannesburg has no museum, and the collection of Africana thus has a special mission to fulfil: it is the nucleus of a national institution yet to be established in South Africa, and it is hoped that out of it may grow a folk museum recording through the centuries the history of the Union. The exhibition was opened by the Earl of Athlone on June 29th and will remain open until July 9th.

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The publication of a new weekly review, to be known as *The Independent*, is announced by Sir Ernest Benn. It will appear in October next under his editorship, with the assistance of Professor T. E. Gregory and Mr. E. G. Hawke. A preliminary circular explains that the rate of recovery from post-war follies "will correspond exactly to the pace at which the spirit of liberty revives. Individual man must once again be encouraged to believe that he counts for something in the scheme of things. *The Independent* makes its bow and its bid for public favour on these simple grounds. Its policy is anti-political. The writer with a scheme for the control of others, the expert in the way that others should behave, the spender of other people's money, the committee-man and the conference-monger who know how to reconcile right with wrong, will find no place in our pages." The review will not, however, be confined to economics and politics, and the announcement that it will deal also with science, literature, and the arts will be widely welcomed. "Some of the most brilliant work in all these departments of endeavour is discouraged by the clever and systematic rigging of the market by socialistic modernists," and many students will agree with the further statement that there is need for independent criticism "even in religion, and not least in science."

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Archaeologists were alarmed to hear that falls of rock and earth had occurred in the cave of Altamira, near Santander, in northern Spain. They will be reassured by the news that the palaeolithic paintings for which the cave is famous are in no danger. Professor Obermaier, the authority on the archaeology of the Stone Age, has visited the cave and reports that the falls of rock took place at some distance from the paintings. The measures taken some years ago to reinforce the ceiling on which are the polychrome paintings of bulls have not apparently been effective. On that occasion the paintings were saved from the grave danger which threatened them by the intervention of the Duke of Berwick and Alba. But their incalculable value as documents in the history of civilization ensures that no appeal to meet any expense necessary for their preservation would fail to meet response from archaeologists the world over.

* * * * *

In the Ashanti rising of 1900, the war fetish of the nation was captured by the faithful levies under Captain (afterwards Sir Cecil) Armitage, and presented to him. It proved to be a bronze tripod ewer of English workmanship, dating from the 14th century. At the same time there was found a silver standing punch bowl with the London hallmark of 1666-7, which had been repaired by native methods. Both these most curious monuments of early trade between England and Africa have been purchased by the Christy Trustees, and presented to the British Museum. Other important antiquities received by the Museum last month are a colossal ram sphinx of the XXVth Dynasty (about 700-660 B.C.), which was found at the excavations at Kawa in the Sudan, and an example of the barbarian practice of mounting Roman coins of the Empire as ornaments. This is a coin of Mauricius Tiberius, Emperor of the East, A.D. 582-602.

Shall We Conquer Everest?

By Brig.-Gen. C. G. Bruce.

All who have read in the Press the brief but vivid messages from the Mount Everest Expedition, under the leadership of Mr. Hugh Ruttledge, have been thrilled by the daring of the climbers. As leader of the expeditions of 1922 *and* 1924, *General Bruce writes of the many problems involved from first-hand knowledge.*

At the moment of writing this article, news has been published in the Press that the fourth Everest Expedition, for the purposes of rest and refreshment, has retired to the base camp after two heroic failures to reach the summit. And so again history repeats itself, for on each of the previous expeditions in 1922 and 1924 it was necessary, after a period of very great exertion, to retire at once to the Base Camp to renew the strength of climbers and porters and probably, as in this case also, to re-establish the morale of the porters.

It is wonderful to think that it has been possible nowadays to get such very rapid reports from so remote a part of the world as Southern Tibet, and that we here in London should be almost in direct touch with the men who are now making this terrific struggle.

Naturally the names of those engaged in the actual climb are prominent in the telegrams: Wyn Harris and Wager, who probably arrived nearly as high on the mountain as Colonel Norton himself—it may have been that they have reached quite as high—and the second attempt by Shipton and Smythe, Shipton apparently getting ill when over 27,000 feet and Smythe making a terribly daring attempt by himself and actually passing the night alone at Camp VI where he is reported as having slept for twelve hours.

Team Work.

There are many interesting points about these attempts, especially the second one which must be touched on later. But before describing what an expedition into Tibet and on to the wild north slopes of the great Himalaya is like, I must ask you to bear in mind that though the spear points are men like Smythe and Wyn Harris, their success depends on the organization of the leader and on the terrific hard work that has to be undergone by those who, equally good mountaineers, have backed them up and who, with the porters, established the different staging camps from which the attack on the mountain can be actually carried out. So I pray readers of the *Discovery* to realize that the marvellous success attained by the front rank of the mountaineers is only an expression of the great team work that is necessary to make such attempts possible. I do not think people quite appreciate the leader's task. Tibet is one of the wildest countries on earth and one of the most trying to travel in owing to its great elevation, and it is also almost devoid of supplies. A great expedition like the Everest Expedition—let us take for instance this last one—consists of some fourteen Europeans and from seventy to eighty specially engaged porters, all of whom have to be kept in perfect health and strength and training for the whole of their period in Tibet. This means outfits for all the Europeans and special food, and to a certain extent provision for the porters across Tibet and to keep them fit too when actually engaged on the mountain itself.

Many Hardships.

Now the distance across from the rail-head or, say, from Darjeeling through the British territory of Sikkim, over the ridges of the Himalaya into Tibetan territory and then across the high plateau, plains and ridges of Southern Tibet, is about 350 miles. In order to get there so as to have plenty of time to attack the mountain, the expedition must leave early in the year, and that means of course having to face great cold and possibly hardship on the journey to the mountain.

A journey of this kind is not comparable with any which one could undertake in the Alps. Here in Tibet we find the country bare of trees, bare of fuel, or nearly bare of either, always with wind; no shelter, no camp fires, having to depend entirely on collected dried yak dung for fuel, and one will understand the discomforts and the chances of wear and tear in your party unless adequate preparations are made.

For many, many centuries Tibet has been one of the least known of countries and even now it is very difficult to obtain permission to cross it. It is a priest-ridden country; and the priests are of a peculiarly suspicious type. The ordinary Lamaistic religion is a mixture of what is remembered of true Buddhism and the ancient demon worship called the Bon religion, which was the religion of the country before Buddhism was introduced and was grafted on to this ancient demon worship. The head of this curious country is the hereditary or rather re-incarnated Dalai Lama who is actually the spiritual and political autocrat of the country. Without his leave it is impossible to move, and unless political conditions are favourable

that leave is hardly likely to be obtained. Having once obtained it, and once carrying the Dalai Lama's permission to travel, most of the difficulties of travellers are smoothed away.

Now to carry such a huge caravan of about a hundred persons, with not only their immense baggage but large supplies of food, technical stores and also scientific and other apparatus needed for the full exploration of the mountain, requires a very large number of animals ; in fact, I think I should be right in saying that this year they employed over three hundred animals, and these animals are mostly the yak of the country, a few mules, very few, and the sturdiest and smallest little donkeys conceivable.

Slow Progress.

Progress is slow, transport has to be very carefully organized and supervised into the bargain or loss may occur as indeed has happened on this occasion, and then one passes from district to district, and such are the customs in Tibet that as a fresh district is entered one has to approach the ruler of the district, who is known as the Dzongpen, and the whole of the transport is there changed.

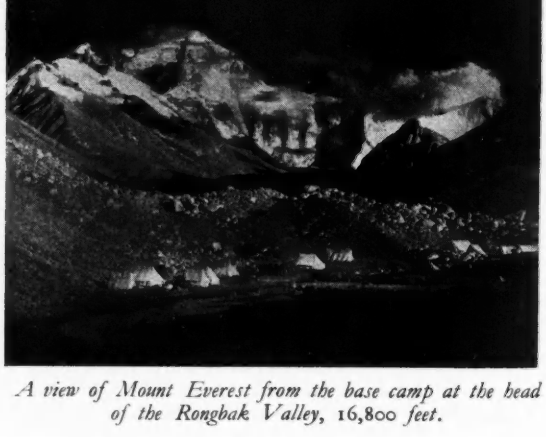
A full month's travel is required from the starting point at Darjeeling to the Rongbak Valley, which leads up to the Everest group, and finally a base is made at the head of this valley, some ten miles from the foot of the mountain and at a height of 16,800 feet, that is about 1,000 feet higher than the top of Mont Blanc.

One of the questions which has interested both mountaineers and physiologists for a great many years and which we now think we have solved, is the question of acclimatization of mountaineers. It is really most interesting to see not only how men of great experience have differed in their methods of acquiring acclimatization but in their theories as to the possibility of complete acclimatization being possible. When one reads the early stories of Himalayan travel and the earlier climbs, one sees that there was an immense amount of disbelief that it was possible to reach any of the very greatest heights. I used to hear as far back as the 'nineties, theories of the most strange type. How one could not possibly sleep above 21,000 feet and that acclimatization should be obtained by journeys up and very quick journeys back again so as to avoid exhaustion. The controversy went on among all kinds and types of people, until it was brought more in front of the public by the great expeditions of the last ten years. Up to a certain extent, however, immense progress had been made a good deal before that time. Graham's expedition in Sikkim and his other journeys in the Himalaya, and again before his time, Johnson, a subordinate in the Survey, had shown that heights of from 21,000 feet and even up to 24,000 feet were possible to men in good training and who were accustomed to hard work at a low barometric pressure.

Later expeditions, even if we do not on this occasion refer to the Duke of the Abruzzi's wonderful work on the Baltora Glacier, have shown very clearly that given the right man and the right type it is quite possible to acclimatize human beings, without outside aid, to the highest points of the earth's surface.

In 1921, when the first expedition went to Everest, still no one had slept for a night higher than 23,000 feet, Mr. Meade's experience on Kamet, on his night out there, standing by itself. Naturally, if one has to attempt to climb Everest one must be prepared to stay for a much longer period at greater heights. Then again the controversy raged as to what was the best method of getting men fit for the final peak. Some were in favour of acclimatizing by climbing high and then returning to a lower base, while another school claimed that by staying very high one could still more easily fit oneself.

It has now been clearly shown that the latter school holds the field. After the experiences of the 1922 expedition, when the 1924 expedition was leaving, it set up a psychological mentality which always spoke of and referred to the camp at the North Col as being ordinary child's play and all in a day's work, and that that camp at 23,000 feet should be the alpine base and one in which people would naturally stay for a considerable period. It is very curious to think that as soon as that psychological outlook had established itself, no one did seem to mind much staying at 23,000 feet, and that in 1924 Colonel Norton and Dr. Somervell slept in more or less comfort at nearly 27,000 feet, and



A view of Mount Everest from the base camp at the head of the Rongbak Valley, 16,800 *feet.*

that the wireless reports Mr. Smythe as sleeping there on his return by himself in comfort for twelve hours.

It can, I think, now be claimed that the question of acclimatization is solved. Of course it is all interwoven with the question of suitable nutrition and of the right person, because naturally suitable nutrition must play a very great part in fitting a man for such an effort. Further, none but the fittest and soundest could possibly be asked to take part in these attempts.

Is it not amusing nowadays to look back to the thoughts of the early explorers in Switzerland, about the time that de Saussure climbed Mont Blanc. There were doubts as to whether a pistol fired on Mont Blanc could be heard, and even doubts as to whether human life was supportable; and to think that for innumerable generations passes in the Himalaya had been regularly crossed by Himalayan natives up to 20,000 feet, and that great trade routes were opened and had been opened for many, many years between Kashmir and Central Asia, trade routes even now used such as the Karakoram and the Saser Passes.

Now having reached the objective, that is the Rongbak Valley, the Base Camp must be established and every effort made without delay to attack the mountain; pace in itself is of the greatest importance. Everest is exposed to the early arrival of the monsoon rains. Until these rains, which are due about June 10th, arrive there is the possibility of fine weather. After that time there is not very much. So it has always been the case that all attempts on the mountain must be made before the arrival of the monsoon. Thus we have from the base camp not more than a month to move all our staging camps up, to get them all ready, fit them out and establish them; and over and above that the alpine base camp must be established at the North Col, which lies directly under the peak and is connected to the advance base which is known as Camp III by some rather difficult and often extremely doubtful snow and ice slopes. This is the scene of the regrettable accident of 1922, and it also forms the greatest question which porters themselves have to tackle. So from the base camp caravans set out and establish Camps I, II and III leading up the East Rongbak Glacier to the foot of the mountain at Camp III. The advance base is made at the foot of the great slopes leading to the North Col. And then comes the mountaineering question. The North Col camp is situated at 23,000 feet, and up those precipitous slopes, in which steps have to be hacked, a mass of stores have to be carried, and there the mountaineers have full scope to show their capacity. When the North Col camp is established from there the actual assaults on the mountain are carried out.

The peak photographed from a camp at 20,000 feet. (Photographs by courtesy of the Royal Geographical Society.)

The unfortunate part about this section of the Himalaya is that, although success is absolutely dependent on fine weather, one very seldom gets it for more than a few days at a time. Early in the year a most disgusting north-west wind blows as cold as it is possible, raising in the valleys great clouds of dust which permeate everything. This wind may or may not bring snow and it may or may not rise to the force of a hurricane, and is the chief enemy of the traveller in Tibet. The three expeditions have had varying experiences; probably the 1924 expedition had the worst. During the month of May the leader hopes for fairly settled weather so that he can establish all his camps in comfort. Throughout the May of 1924 hurricane after hurricane was experienced, which wore out the powers of the party before they really arrived at the mountain.

Full accounts are not home yet of our present expedition, but it is quite apparent that they have also discovered what a north-west hurricane on Everest can be like. A little later full details will be obtained, and then I think it will be found that their difficulties were almost as great as in 1924.

We have heard from the Expedition which flew over Everest, and even from the climbing party, of the difficulties which might occur, or possibly from the offences which might be given to the gods of Everest, but this little point requires to be cleared up. The Hindus on the south side undoubtedly consider the Himalaya the home of many members of the great Hindu deistic hierarchy, but let me assure you that on the north side the mountain is considered only to be the home of demons headed possibly by the Sokpa chief. When a hurricane blows on Everest, or the gods are otherwise upset and terrible noises are heard

in the mountains, services are held at the Rongbak Glacier exorcising the demons, either that they may stop sending epidemics into Tibet or for the re-establishment of decent weather again. Such services were held for us in 1922 when the winds were rather more boisterous than they should have been. And so it is pleasant to remember that we are not upsetting the private residences of more or less respectable and much respected gods and goddesses but are only dealing with much more unpleasant creatures for whom we need not have in any way pity or respect.

One does not find on the northern side that glory of the mountains which overwhelms the explorer of the southern side, and which so impressed the Kangchenjunga expeditions and Mr. Smythe when climbing on that side. But for really wild savageness and roughness and wickedness, the great hard and rather ugly strong faces of the north of the same mountains grow on one mightily.

There has been much controversy about the real name of Everest. It has now probably been solved by an article by Colonel Kenneth Mason, and it really comes down to the fact that there is not and never has been any actual name for the peak itself such as Kangchenjunga has, but two names are familiarly used—on the North Chamalung, and on the South Chomolunguna (both by Tibetans only) which apply to the massif, to the whole group. This may or may not be the case, but the name of Everest is so splendid and so intensely suitable that it is impossible to think that it will ever now be changed, and so General Everest, one of the greatest of all Indian surveyors, has a monument to his work unequalled by any other of his profession.

A Century of British Entomology.

WHEN the Entomological Society of London recently celebrated its centenary, the occasion was marked by the King's command that it should in future be designated Royal. This is the final recognition of the work done in academic and applied entomology by three generations of enthusiasts. There can be few scientific societies in the world that have completed a century of brilliant achievement without the protection of an official or academic body.

Although it is exactly a hundred years since the Society was formed, its roots go back at least as far as 1745. The first entomological society in the world of which there is any authentic record is the Aurelian Society, which was in existence at least at that date. Hagen records that it used to meet in the Swan Tavern in 'Change Alley, where it was burned out on March 25th, 1748. Then, it is surprising to learn, it already possessed a library and collections which were unfortunately destroyed. In 1766 Moses Harris dedicated his " Aurelian " to a second society of that name, and in 1801 a third was in existence.

At last, on May 3rd, 1833, a party of scientific men passed a resolution " that a society be established for the promotion of the science of entomology in its various branches." The problem of a home for its library and collections was at times so acute that it seemed almost as though the Society would become extinct. But in 1875 it found a rest in the rooms of the Medical Society in Chandos Street, where it was housed in comfort and dignity until it acquired its own freehold premises in Queen's Gate in 1920—the greatest landmark in its history since the grant of the Royal Charter in 1885.

One noteworthy characteristic of the Society is the dominance of the amateur through its history, for it is only in recent years that the applied entomologist has appeared on the scene in any strength. At the first International Congress of Entomology at Brussels in 1910 there were present but few pioneers of the profession, the importance of whose functions are even now only dimly realized. It seems incredible that almost throughout the Victorian period practical entomology was left to a lady, the late Miss Eleanor Ormerod, who was so far ahead of her age that she began to take an active interest in economic entomology as far back as 1852.

Within a few years of its foundation the lovers of insects who formed the society were awake to the great importance of the practical side of their science. As early as 1834 the Agricultural Society of Grenada consulted the Entomological Society of London as to the best means of dealing with the sugar cane leaf hopper, *Stenocranus saccharivora*, Westw., then causing serious depredations in plantations. In 1837 we read of the members discussing the damage done by *Dermestes* to pictures in the National Gallery.

To-day it seems incredible that leading men of science should ever have opposed speculation in entomology. Yet on June 6th, 1883, Professor Westwood, speaking from the chair with all the authority of his great prestige, offered the following advice : " I would earnestly discourage my younger hearers from following this attractive (Darwinian) theory too far " ; and Professor Poulton relates that when he was a student at Oxford, Westwood seemed to think the authorities of the university and his college had acted imprudently in allowing so dangerous a book as " The Origin of Species " to reach the hands of so young a man.

Discovering a New Hydrogen.

By A. S. Russell, D.Sc.

For the first time in history a chemical element has been divided into two completely different parts. A new "heavy" hydrogen has been separated from the old, and its properties are now being studied by chemists.

DURING the past few months scientists in the United States have been working on a small but highly interesting thing: a form of hydrogen, the atoms of which were discovered last year to be twice as heavy as ordinary hydrogen atoms. Every chemist is aware that the lightest atom in the whole of nature weighs 1 on the scale of atomic weights. Every chemist is also aware that an element need not have all its atoms of equal mass. Atoms of carbon, for instance, may weigh 13 as well as 12; atoms of oxygen 17 and 18 as well as the more usual 16. This form of variety is common to most elements, nevertheless it was not believed to apply to hydrogen. The simplest alternative to a mass of 1 is one of 2, *i.e.*, a difference of a hundred per cent in atoms of the same element. This, if it was ever seriously considered, was regarded as beyond belief.

Last year, however, Messrs. Urey, Brickwedde and Murphy obtained evidence that in ordinary hydrogen there is one atom weighing 2 to about four thousand weighing 1, and experiments were immediately put in hand to effect a concentration of the new atom. An unexpectedly good method was soon found. The molecule of water, it is well known, contains two atoms of hydrogen to one of oxygen. When a current is passed through water, when, in other words, it is electrolysed, hydrogen goes to one pole (and is removed as gas there) and oxygen to the other. When a very large volume of water was electrolysed until more than 99 per cent of it had been changed to oxygen and hydrogen, it was found there was an enormous concentration of the hydrogen atom weighing 2 in the water which remained; not a complete separation of the atom 2 from the atom 1, but nearly so. The density of this water when purified by distillation was 10 per cent greater than that of ordinary pure water; its boiling-point, freezing-point, and other important physical properties were noticeably altered.

As this excellent method of separating the new hydrogen from the old is slow, manufacturers both in England and in America have been asked to send their "electrolytic liquors" to research laboratories in order that an investigation of the double-weight hydrogen may be carried out there with all speed. In America especially there has been a race to find out the new properties of heavy hydrogen, and already a large number of researches on the subject have been printed, chiefly with regard to physical properties such as spectral lines and those already mentioned. Chemical work is now being done. Sulphuric acid is H_2SO_4. What effect on the properties of this liquid will the substitution of two atoms weighing 2 for the two which weigh 1 have? That has yet to be done. In organic compounds hydrogen is often an important constituent. It will be interesting to see how the substitution of heavy for light hydrogen will alter the chemical character of the compound. In some compounds hydrogen is known spontaneously to jump from one atom to another and back again. It will be interesting to see how this property will be effected by making the jumper twice as heavy. Quite a new and comic organic chemistry may grow up, although in a great number of compounds the new atom will not be expected to have any effect on properties.

One minor consequence of the discovery is that there are now known to be 169 different forms of benzene, the compound of formula C_6H_6. (This is a chemist's not a mathematician's calculation, because it depends upon the knowledge that there are two different atoms of carbon and on how carbon is joined to hydrogen in the compound.) In a physical laboratory in California the new hydrogen atom has been used in place of the lighter one to effect atomic disintegration by bombardment. It has been found to effect the same kind of atomic disintegration but its "punch" is, naturally enough, much greater.

A Bewildering Discovery.

The old-time chemist would be a little bewildered by this discovery. He was accustomed to regard an element as made up of absolutely identical atoms; he used to define an element as a substance which could not be divided into atoms of different kinds. His simplicity got its first shock when he was compelled to believe that in some elements a small proportion of atoms might have a small integral difference in mass from the commonest kind, but the blow was softened in that no method for effecting a complete separation of one kind from the other could be found; the best that could be done was to effect a small concentration of one in a mixture of both. With hydrogen, however, the concentration is so easily done that it is practically a complete separation. For the first time in history an element has been separated into two parts as different as sugar from sand. Each, if you please, is hydrogen. One is not the element, the other an impurity in it. Each is the element. Each is hydrogen.

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Exploring the Antarctic in the "Discovery II."

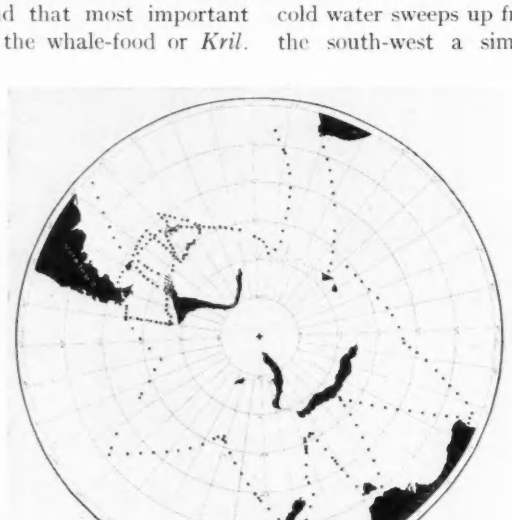
By J. W. S. Marr.

The phenominal expansion of the whaling industry in recent years has called for wider information about the distribution of the whaling grounds. The author describes the latest and longest voyage of the research ship "Discovery II," which has circumnavigated the Antarctic continent in a series of cruises.

On May 5th the royal research ship *Discovery II* returned from her second long voyage of research in the Antarctic, in the course of which, in addition to other work, she circumnavigated the southern continent during the winter of 1932. The Discovery Investigations, to which the voyage of *Discovery II* is the most recent contribution, were begun in 1925 and are controlled by the Discovery Committee, acting on behalf of the Government of the Falkland Islands.

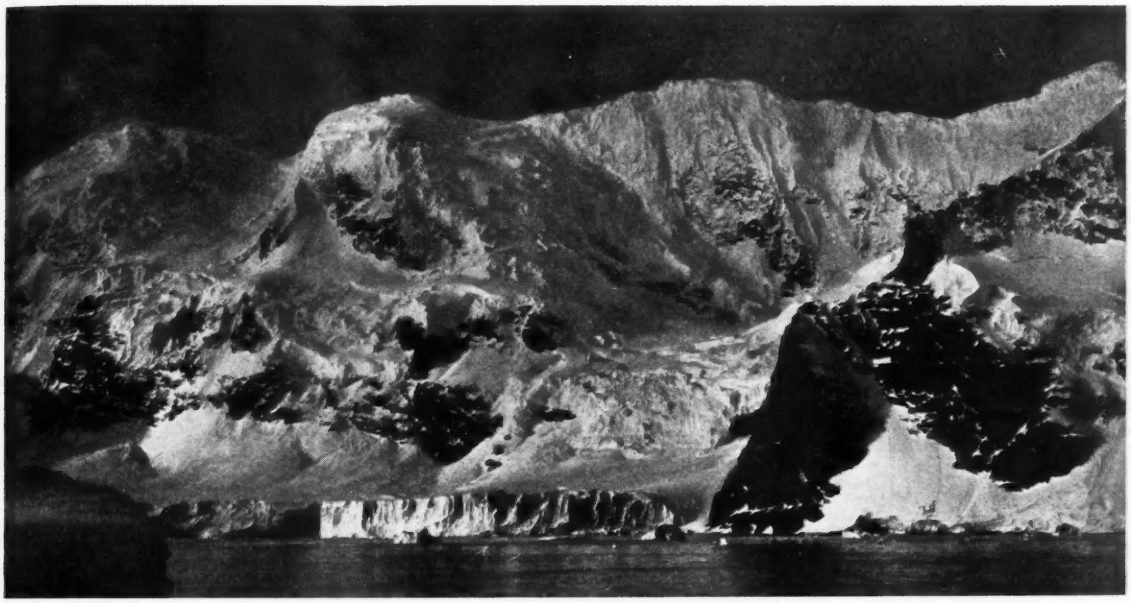
The first Antarctic voyage of *Discovery II* was described by Dr. N. A. Mackintosh in this journal in October, 1931. He pointed out that the primary objective of the investigations is the acquisition of sufficient knowledge concerning the distribution and movement of whales and the complicated factors which affect them, on which to base regulations for the control of the great southern whaling industry. Dr. Mackintosh further described the lines on which the investigations are carried out at sea, by a system of routine observing stations, for which an elaborate equipment is required, including several grades of fine-meshed nets for capturing the small drifting animals of the Plankton, and that most important constituent of the Plankton, the whale-food or *Kril*.

The investigations, under the leadership of Dr. Stanley Kemp, F.R.S., were started at a time when the whaling industry was centred round South Georgia and the Antarctic islands lying to the north of Graham Land, the South Shetlands and South Orkneys. As a first step it was decided to make an intensive examination of the whaling grounds in the immediate vicinity of these islands, and accordingly the work for the first four years was mainly confined to the Falkland sector of Antarctica, and particularly to the rich grounds of South Georgia where it was undertaken in conjunction with statistical observations on the whales themselves at one of the land stations. The sea for a hundred miles all round the island was combed by a series of net hauls, taken together with observations on the temperature and chemical composition of the water from the surface to the bottom.



The dotted lines in the chart show the series of V-shaped cruises made in the Antarctic.

Probably never before has any part of the ocean been subjected to such a thorough examination; nor has work of this nature been carried out under such trying conditions, for the seas surrounding South Georgia are cold and tempestuous. Nevertheless, as this mass of data was being examined at home and the myriad animals which had been caught in the nets were being sorted, identified and counted, it gradually became evident that we should have to go farther afield in order to arrive at an adequate understanding of the hydrological and planktonic problems of the South Georgia whaling grounds: for these grounds are influenced directly by two great current systems, and to a lesser extent by a third, each system carrying a complex community of drifting animals peculiar to itself. From the south and south-east a current of cold water sweeps up from the Weddell Sea, and from the south-west a similar current comes from the Bellingshausen Sea. The third and lesser influence is that of the great west wind drift system, a current which sweeps through the passage between Cape Horn and the South Shetlands and, passing a little to the north of South Georgia, girdles the earth. Latterly, therefore, more attention has been paid to this wider aspect of the problem and the whole of the area from west of Cape Horn to east of the South Sandwich Islands has been examined by a great series of parallel north and south lines of stations, extending southwards to Graham Land and the fringing



The magnificent confusion of the great ice falls on the south of Coronation Island is among the finest spectacles in the world.

islands and pushing far south-west of Graham Land and into the Weddell Sea.

Meanwhile, new methods were being adopted by the whaling industry which made even more extended observations necessary. Developing along pelagic lines whaling had rapidly reached an enormous scale until in 1930 floating factory ships, with their consorts the whale catchers, were to be found encircling three-quarters of the Antarctic continent, from Graham Land eastwards to the Ross Sea. The need for wider information, together with the phenomenal expansion of the whaling industry, led to the extension of the observations farther and farther afield, and ultimately to the winter circumpolar cruise of 1932.

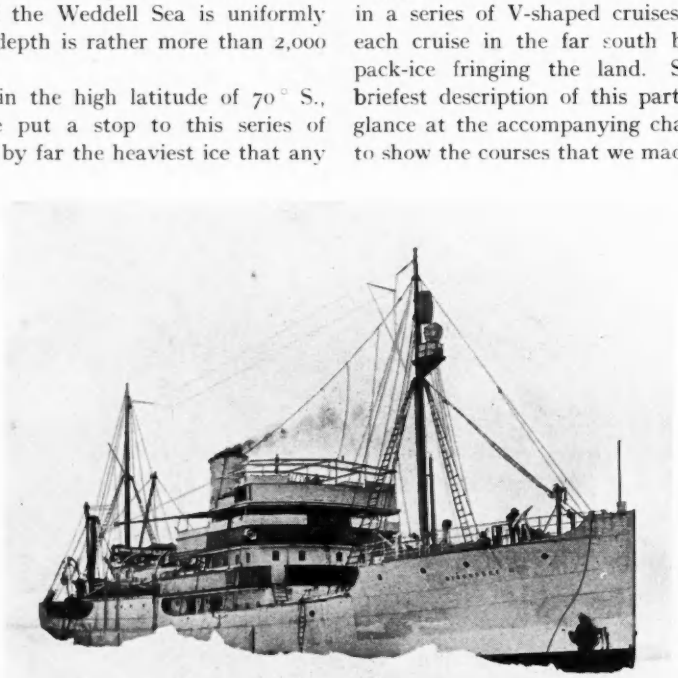
The *Discovery II* left London on her second commission early in October, 1931. She carried a scientific staff of five under Mr. D. D. John and was commanded by the late Commander W. M. Carey, R.N. (retd.). We reached Port Stanley in about a month, having spent some time in studying the oceanic conditions met with on this long passage.

The greater part of the southern summer, from November, 1931 until the end of January, 1932, was spent in making an examination of the waters of the Falkland sector of Antarctica on a more extended scale than had hitherto been attempted. According to our usual practice the work involved the running of long parallel lines of observing stations in a north and south direction, each line crossing some or all of the three major current systems or water masses which have already been described as characterizing this region. This practice of running many lines of stations across different water masses has made it possible to define with great accuracy the boundaries between one kind of water and another, and to determine the nature of the complex animal communities which are peculiar to each. On each of these lines, which extended in the north from about the latitude of the Falkland Islands, we pushed as far south as we could until pack ice made further progress impossible.

The work was begun with a line, some distance west of Cape Horn, which was eventually held up by ice in lat. 64° S. west of Graham Land. Turning eastwards we followed the ice edge for several hundred miles, towing nets at intervals, until we arrived at the point where we turned north again on our second line of stations. And so we worked slowly eastwards until in early January, 1932, the last and most easterly line of this series was commenced. We left South Georgia for this purpose on January 5th, and proceeding to a point some little distance to the north-east of the South Sandwich Islands, turned southwards towards the Weddell Sea. Loose ice was encountered in lat. 60° S. and for 600 miles we steamed through it, our progress to the southward being rendered easy by the presence of long narrow lanes of open water. Twice every day, in the morning and at night, the ship was

stopped and a complete series of biological and hydrological observations was made. Water samples and temperatures were taken from the surface to the bottom and fine, medium and coarse townets were fished at various standard depths down to 1,000 metres. The floor of the Weddell Sea is uniformly flat and the average depth is rather more than 2,000 fathoms.

On January 18th, in the high latitude of 70° S., impenetrable pack-ice put a stop to this series of observations. It was by far the heaviest ice that any of us had yet seen, stretching solidly to the southward without a single crack through which a ship might force a passage. It had apparently been subjected to enormous pressure for great floes had been rafted up and were piled high in indescribable confusion. We realized then the nature of the forces which had overwhelmed the *Endurance* in 1915.



For several days the "Discovery II" threaded its way among the rocks and narrow channels with which the South Orkneys abound.

We turned north on a course slightly to the westward of that by which we had entered the Weddell Sea, in order to break new ground and increase the area of our observations. Unexpectedly heavy ice barred the way and our progress became slow and laboured. Unfortunately while in the pack the rudder was twisted and a leak developed in one of the fuel tanks. Temporary repairs were made and after considerable effort we reached the open sea, the ship being warped ahead in the most difficult places by the main winch with the trawl warp led out to a kedge on the floe, while all our available people were aft with long poles pushing the heavier floes clear of the damaged rudder. Being now clear of the ice, we returned to South Georgia, and here the damage was made good sufficiently to enable us to proceed to South Africa, where we underwent an extensive refit in dry dock.

We now entered upon the most interesting part of the voyage, the circumpolar cruise, which but for the damage sustained in the Weddell Sea would have been begun from South Georgia. This lengthy voyage started from Cape Town on April 8th, and throughout the winter of 1932, from April to September, we were engaged in circumnavigating the Antarctic continent in a series of V-shaped cruises, the turning-point of each cruise in the far south being the edge of the pack-ice fringing the land. Space allows only the briefest description of this part of the voyage and a glance at the accompanying chart will have to suffice to show the courses that we made. By far the longest cruise of the series was that from New Zealand to Port Stanley, which occupied thirty-nine days and taxed the great steaming radius of the *Discovery II* to the full. It was done in the form of a double V or W, thus greatly increasing the compass of our observations in this vast and little known part of the Antarctic ocean. With our return to the Falkland sector in early October the major part of the circumnavigation was completed; the area between South Georgia and South Africa still remained to be examined but this could not be done until March of this year.

On all the cruises of the circumpolar voyage, routine observing stations, similar to those described in connexion with the Weddell Sea, were conducted every day, and thus for the first time in history a complete series of comparable observations has been obtained during the dark winter months throughout the Antarctic and Southern Oceans. On the chart these observing stations are represented by the black dots.

The weather on the whole was surprisingly good although we generally experienced some trouble in the disturbed area of the west wind drift. The ship, however, was so superbly handled by Captain Carey and his officers that it was possible to work stations in anything short of a full gale, and even then, although

fine-meshed nets would have been destroyed, we could generally work water-bottles and coarse townets. In the depth of winter, cold weather on the edge of the pack-ice caused some difficulty, for the nets became like boards as soon as they brooke surface and the wires on which we lower our nets and instruments froze solid in the blocks. The nets were easily thawed again by dipping them in hot water and the wires were kept on the move by the constant application of burning torches below the blocks.

Throughout this long voyage, and on all other cruises of the commission, soundings were taken every half-hour with the deep-sea echo-sounding machine. These close soundings (roughly, one was taken every five miles) have yielded much new information on the topography of the sea-bed, and our knowledge of existing ridges, until now imperfectly known, has been largely supplemented. Such ridges, by deflecting currents from their normal course, exercise a profound effect on oceanic circulation and an accurate knowledge of them is thus of prime importance to the hydrologist.

In the depth of winter the nets became like boards as soon as they broke the surface. The nets were thawed by being dipped in hot water.

On our return to the Falkland sector in early October the whole of the observations which had been made during the preceding season and which had already been described, were repeated, the work being completed by the end of December. The month of January, 1933, was set apart for survey work in the South Orkneys, a group of poorly charted islands lying two or three hundred miles to the east of Graham Land in lat. 60° S. Their scenery is most impressive and the magnificent confusion of the great icefalls on the southern aspect of Coronation Island, the largest of the group, is surely among the finest spectacles in the world. For many days we threaded our way slowly among the rocks and narrow channels with which the islands abound. Frequent landings were made at points hitherto unvisited, for the purpose of collecting plants and animals and rocks, and the opportunity this gave us for pulling and sailing in small boats was welcomed by all after the somewhat wearying routine of a long oceanographical programme.

During this period a series of successful whale-marking cruises was being undertaken round South Georgia in a whale-catcher by a member of the scientific staff detached for the purpose. The marking of whales, by means of small darts fired from pursuing vessels, has for long been an important part of our work, and although many whales have been marked in the past it was found that our early darts, which were experimental, were ineffective in retaining a permanent hold in the whale's blubber. An improved dart has now been produced, with which on the recent cruises 220 whales were marked, and it is hoped that the speedy return of these will shed light on the migratory movements of the southern whale population.

At the conclusion of the survey operations in the South Orkneys we paid a brief visit to the Falkland Islands. Then we set off on the last stage of the cruise. Working two stations a day we again crossed the Antarctic circle and reached the high latitude of 70° S. a little to the west of Enderby Land. Here, in the far south, we commenced a series of deep observations which, with a brief visit to Cape Town for fuel, were continued right up the middle of the Atlantic and did not cease until we had again crossed the equator and entered the northern hemisphere. This work was planned with a view to investigating the cold deep current which everywhere flows from the Antarctic towards the tropics. The essential nature of this current must be thoroughly understood before we can complete the picture of oceanic circulation in the southern hemisphere.

Contemporary Design—1.

Should the Modern House be a "Work of Art"?

By Edward Halliday.

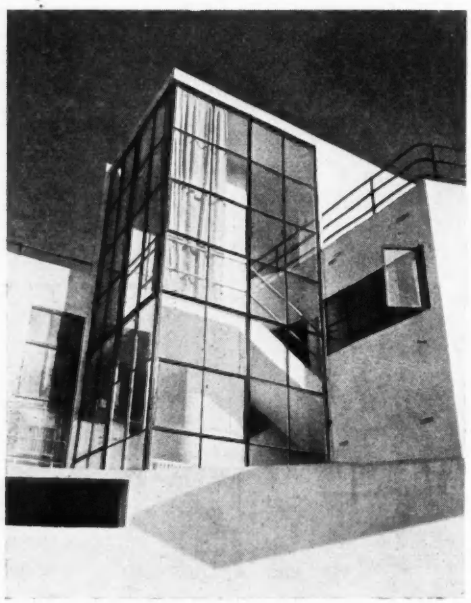
This is the first of a series of articles on contemporary design. The author discusses modern tendencies in design and decoration forming part of the house itself; next month he will write of styles and tastes in applied decoration. Further articles on other branches of art will be contributed by well-known experts.

Is the dwelling house to be considered as a work of art in itself or as a background, a setting, for another art—the Art of Living? Are we to build houses which look pleasant; that is, which fit in with accepted ideas of what pleasant dwellings should look like, or must we plan them to accommodate the sort of life lived to-day and, becoming accustomed to the resultant shapes and accepting them as a logical solution, declare them pleasing?

In answering this fundamental question one states a definite point of view. Either one believes that "fitness for purpose" must be the root principle of all good design and that things made in this spirit can be beautiful and give pleasure to the mind as well as comfort to the body, or one prefers the styles of bygone days and is willing to put up with minor physical discomforts in return for the delight to be found in the repetition of old forms, traditional designs and the reproduction, even by a machine, of handcrafts.

The stylist asserts that a building should not only harmonize with its surroundings but follow a tradition in design which has the approval of generations of critics. If it is in the country it must be in tune with the countryside, must blend with its natural setting. The modernist reply to this is, "Find me a natural setting and I will design you a building in keeping, but if by 'nature' you mean, as you usually do, 'the countryside,' I would remind you that this is not natural but man-made, and any well-designed man-made building should harmonize with it. A Tudor farmhouse was once modern, and to copy to-day its half-timbering and ornamental barge-boarding is nothing but ancestor worship. It is to admit the failure of your contemporaries to produce decent work; for tradition, it has been said, is the next best substitute for talent. If your buildings are up-to-date in plan and yet larded over with a veneer of Tudor or Georgian or Renaissance or whatever style you favour, that is downright sentimentality."

The modern, the contemporary, designer seeks to solve contemporary problems using the materials and methods of building construction of to-day and finds beauty in achievement. He does not think it necessary to hide behind the outward forms of bygone times. To him the exterior of a building, be it dwelling house or opera house, is something which "happens"; it is the logical outcome of the plan, as the plan is the logical outcome of the purpose of the building.

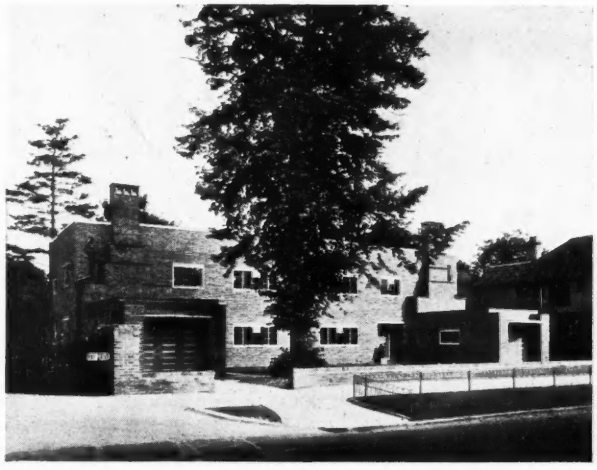


An exterior view of a modern staircase. The heating boiler flue, in the form of a column, is the chief support of the glass-walled staircase. Design by Connell & Ward. (Photo by courtesy of Crittalls.)

Ancestor worship in design usually results in taking from the past some, often superficial, motif of decoration or construction and applying it to an object otherwise intended to satisfy a contemporary need. It is to look at things always from the outside. No one to-day expects a house to be Tudor all through, and few would choose eighteenth century houses which were not equipped with up-to-date sanitation and lighting. The worshipper of tradition demands that his house should *look* Tudor or Georgian but not *be* Tudor or Georgian—its style must only be skin deep—and there are architects who design to catch the fancy or obey the whim of this sort of client by means of exterior style

and decoration and then, often with extreme difficulty, fit into the "period" shell the accommodation desired and expected by a twentieth century man.

"But this," says Eric Gill, in his recent book *Beauty Looks After Herself*, "is to view things inside out. The primary necessity and origin of human building is the provision of habitations, of coverings, of roofs, of shelters—whatever word you like to use. Architecture is not to be thought of as a thing with a hollow space inside it, but as a covered space—a hollow space with a covering, and a covering naturally has an outside. The Greek temple and the mediaeval cathedral both alike were designed from the inside outwards. The outside is the consequence of the inside and owes its character and quality to the character and quality of the inside. A contrary view turns architecture into play-acting, the making of stage scenery; and stage scenery is the only name really applicable to most architecture since the Renaissance until recent times."



Two houses at Maidenhead, which were among the first flat-roofed dwellings to be built in brick. (Photo by courtesy of Alan Fortescue.)

The main purpose of building—apart from monuments—is to satisfy a physical need, and if our needs and habits were the same to-day as in the fifteenth century, and our methods of building construction, our tools and materials were the same, then the Tudor style for domestic buildings would be right and proper. As, however, this is far from being the case, the "Tea-Shop Tudor" villa so familiar throughout the length and breadth of the country, is just stage scenery. Unblushingly, suburbia runs its 1933 car, of whose up-to-dateness and mechanical efficiency it is justly proud, into a fake half-timbered garage. Radio sets are "dolled up" to look like Chinese lacquered cabinets or Charles II chests; the "lounge-type" villa, with its mock baronial lounge hall, its leaded windows and enormous fire-places (complete with Ye Olde Flickering Yule-logge Electric Radiator) and furnished throughout by what Lethaby called the Cocked-hat and Candlestick School, is the perfect example of play-acting.

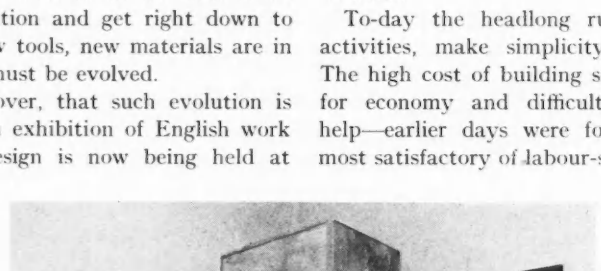
No one would dream of going about to-day in the costume of a bygone age, yet many rig out their homes in the fustian of Wardour Street—being constitutionally incapable of calling a spade a spade. A motor-car whose body-work was in the shape of a stage coach or whose bonnet took the form of a horse's head would be ridiculed, and yet there are electric kitchen stoves with cabriole legs, petrol stations with thatched roofs (each separate pump having its own particular thatch) and in Hampstead, near the Heath, there is a house whose tradesmen's entrance bears the legend, in Olde Englishe lettering, "Ye Mërchaunts' Entrance"!

If it is true that this passion for "ye olde," this ancestor worship as it has been called, is a result of the refusal to recognize contemporary talent, it is also true that such talent has not as yet evolved for us a style sufficiently identifiable with the spirit of our times to be comparable with the great styles of the past. There is no definite substitute. The designer of to-day, reacting not only from all the fakes and superficial reconstitutions of the decoration of early periods but also from the almost complete lack of style of the nineteenth century, has gone back to first principles. As it is first the physical needs of man which must be satisfied, the designing of a house, of furniture, of everything for his use must begin inside. The house must first of all be a machine to live in; a chair an object in which to sit for reading or writing or eating or lounging, a cup something from which to drink, and light fittings must be designed to produce adequate light. If this results in what some consider starkness, lack of human atmosphere ("Am I a *car* and is my house just a place to *park* myself?"), it does at least supply necessities, and the bones, as it were, are right.

If we are to develop a style which is as closely related to our times as were the Tudor, the Renaissance, the Georgian to theirs, then we must begin again at the beginning. It is impossible to carry on the eighteenth century tradition. The Victorian era

cannot be bridged, for the Industrial Revolution has landed us with machines we cannot ignore ; we must neither fight them as did Morris and his Brethren, nor use them for the mass-production of imitation handwork as was the practice of the Victorians. If we are to use our machines at all we must make a clean break with tradition and get right down to the roots of design. New tools, new materials are in our hands—a new style must be evolved.

There are signs, moreover, that such evolution is in fact taking place. An exhibition of English work in many branches of design is now being held at Dorland House, Lower Regent Street, London, and will remain open until July 12th. Here is shown the emergence of a style, a thread connecting the designs of all kinds of various objects, the flowering of a common aim.



A bathroom designed by Arthur Shearsby, with shower screen in fumed glass and chromium framework. (Photo by courtesy of Shearsby and Colson.)

In planning the dwelling of to-day it must be remembered that the developments of modern life have changed our conditions of living. Much less time is spent in the house than formerly. Sport and games, motor-cars and easy communications generally which lead to wider interests, take us away. Indeed to many the house of to-day is but a dormitory. The Victorians, leading a more orderly existence, not necessarily with fewer interests but certainly with fewer means of indulging them, surrounded themselves with elaborate decoration. Their homes were museums housing objects which not only gave delight intrinsically but also aroused pleasurable associations. The house was considered as a work of art, to be decorated and embellished in the taste of its occupants. The aim was " The Home Beautiful," a worthy monument to the ideals of family life, and as such it was frequently successful.

The taste of to-day in the decorative arts happens to be different ; but it is the different aim, to make a house first a good place to live in, to move about in, to rest in, which separates us from the Victorians. The actual planning of the nineteenth century house was in most cases extremely uneconomical both of space and of labour. Basement kitchens were separated from the dining-room by long passages and stairs, and the materials used in the actual building as well as the decoration were costly and difficult to clean.

To-day the headlong rush of life, the manifold activities, make simplicity in the house essential. The high cost of building space, the general necessity for economy and difficulty in obtaining domestic help—earlier days were fortunate in affording that most satisfactory of labour-saving devices, a large staff of servants—compel the designer to use what brains he possesses in the preparation of a functional plan and to rely on the beauty of simple architectural proportions to achieve his decorative effects. His problem is a new one. While the small house must have more rooms than formerly, the large house needs fewer. The size of families has diminished ; a smaller unit is to be housed, and standards of health and cleanliness, of space and air differ to-day from those of yesterday. The growing popularity of the living room as the central dominant feature of the modern dwelling—in itself really a return to the mediaeval hall which was the communal room used for all the main activities of the house of the fifteenth century—has completely altered the design of the house. The sitting-rooms, parlour, drawing-room, morning room, study, library, ballroom and so on have all been kaleidoscoped into the living room, and even the dining-room in some cases is accommodated in an alcove.

It may seem more civilized, more spacious certainly, to have a separate room for each function—a parlour for conversation, a drawing-room to which to withdraw after a meal in the dining-room, a library for a quiet hour among one's books, a room to dance in and " a room of one's own " to work in—but these must in most cases be relinquished in favour of the increasing activities outside the home. The small family unit

has led to a larger number of flats and apartments, the splitting up of existing houses as well as the construction of new " blocks," and here the development of the living room is an obvious solution to many difficulties.

The plan for the remaining accommodation, the dining-room, the bedrooms, the bathroom and kitchen, naturally pivots about the living room. Bedrooms are small, adequate space for the storing of clothes, for a desk and so on, being found in built-in furniture. In some cases bedrooms are fitted with bunks, one above the other, or beds which hinge up into the wall when not in use. The kitchen and bathroom are considered purely from a functional standpoint and are as light and spacious as may be, with clean efficient fitments ; they are laboratories on the one hand for the preparation of food and on the other for that personal cleanliness which is characteristic of our times. To-day the fitments for bathroom and kitchen are of extremely high quality, even pots and pans are sensibly if not beautifully designed and the kitchen is very often the most pleasing room in the small house on that account.

A sittingroom-bedroom by Edward Halliday, with folding bed behind curtains and flush reading lamp above. (Photo by Joan Woollcombe.)

The dining-room, where it is not incorporated in the living room, is small and clear of all but essential furniture, and is conveniently placed for direct service from the kitchen and with easy access to the living room. Comparatively little, though admittedly important, time is spent in the dining-room and the simplest plan to fit it for its purpose is a natural economy.

The concentration of functions in the living room means an equal concentration of furniture. With so many activities to be accommodated in one room the planning of space becomes intricate, and it is the ingenuity of the designer in solving this problem which commends him to us. There is a demand for less and smaller furniture, for " unit " furniture, and for the dual-purpose piece—the table-bookcase, table-stool, even bed-settee, which converts the living room into a bedroom for the unexpected guest, and though this last is becoming increasingly popular in the small dwelling, it is by no means new. It is as old as the problem it solves. Goldsmith's

> " . . . . chest contriv'd a double debt to pay
> A bed by night, a chest of drawers by day."

must have been something of the same kind.

Most houses and flats are fitted as a matter of course with kitchen cabinets and refrigerators, hanging cupboards in bedrooms and so on, and in the future fitted furniture—built-in furniture—will be as usual. In the rented house it has obvious disadvantages but, after all, to-day one takes for granted the fitted bath, kitchen equipment, lighting and water systems. They are an essential part of the building. A time will come when it will be as ridiculous for us when moving from one house to another, to remove wardrobes, chests, desks and settees as it would be for us to transport our baths, kitchen sinks and fireplaces to-day. Besides saving the space usually taken up by the back and sometimes the sides, fitted furniture is very easy to keep clean, having few spaces where dirt can lodge. Fitted bookcases are already universal ; radio cabinets, desks and cocktail cabinets are now incorporated in the room, and in most cases provide ample material from which the designer builds up his decorative scheme.

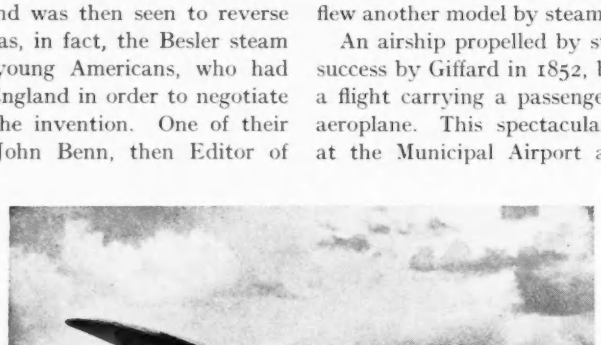
Electric lighting, at once one of the most decorative as well as useful features of the contemporary dwelling, is at last receiving the attention it deserves at the hands of the modern architect. Too long have we endured the dangling centre-light with its dust-collecting flex, the sconces with imitation candles whose permanent drips give such an obvious lie to the bright, still " flames " of the lamps. Modern lighting is considered as part of the house and not as an afterthought, and many electric fittings to-day, lamps and switches alike, are of sensible and attractive design.

Steam Power for Aircraft.

The Besler System.

What is believed to be the first flight ever made in a steam-driven aeroplane has been achieved in California. By special arrangement "Discovery" is able to publish the first particulars of this interesting development.

FIVE years ago the residents of a quiet London street were startled one Sunday afternoon by the shriek of a steam whistle, as a powerful motor car accelerated to forty miles an hour and was then seen to reverse at the same speed. It was, in fact, the Besler steam car, developed by two young Americans, who had brought the machine to England in order to negotiate the European rights in the invention. One of their first visits was to Mr. John Benn, then Editor of *Discovery*, who had been a fellow student at Princeton with Mr. George Besler and his brother William in 1922. At the University the inventive bent of these two men was not suspected, but after graduating in engineering they were soon absorbed in the work on steam power, which has resulted in the development of the Besler system. Its chief applications are, naturally, to railway locomotion, buses, and marine power plants, but the steam car, followed this spring by the first steam-driven aeroplane, has shown in spectacular form the remarkable degree of efficiency attained by this particular system.



The steam-powered aeroplane about to make its first flight at the Oakland Aerodrome, California.

The successful flight of the aeroplane, believed to be the first ever made in a steam-driven machine, was accomplished in California on April 12th by Mr. William Besler and now his brother has again come to Europe in connexion with this latest development. Except for a photograph of the machine, no information has yet appeared in the English Press and by special arrangement with the inventors, *Discovery* is now able to give the first particulars.

The idea of using steam for aircraft dates, of course, from the early days of the steam engine, and about a century ago an English engineer named Henson projected a large aeroplane to be driven by steam. He under-estimated the power required, and his plan fell through, but one of his associates, Stringfellow, succeeded in flying a model steam aeroplane. Experiments were later made by Maxim, and Langley flew another model by steam in 1896.

An airship propelled by steam was flown with some success by Giffard in 1852, but not until this year was a flight carrying a passenger made in a steam-driven aeroplane. This spectacular achievement took place at the Municipal Airport at Oakland, California, in a biplane originally built for a Curtiss internal combustion engine, which was taken out and substituted by the Besler power unit for this experiment. There was found to be ample room and while considerable ingenuity was required, no difficulty was experienced in making the steam plant compact enough to fit into the available space. The installation, however, included many parts taken from a Doble steam-car which were unnecessarily heavy and in some cases too large for the purpose. No attempt was made to develop either extraordinary power or to make it extremely light. The immediate objective was to build a power plant capable of flight.

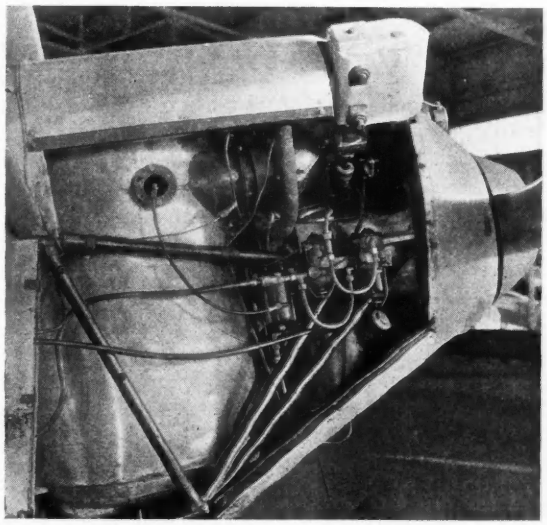
The unit consists of a two-cylinder engine, which delivers approximately 150 h.p. at 1,625 r.p.m. The weight is about 180 lbs., and no serious attempt was made to make the engine lighter. The boiler consists of a single tube approximately 500 feet long, and is built according to a patented design, the chief improvement over previous boilers being that the temperature remains constant regardless of the pressure, and the control is entirely automatic. The efficiency is very high.

The engine is fitted with a steam feed water pump, the exhaust steam from this pump being used to preheat the feed water entering the boiler. The power plant condenses almost 99 per cent of the water used, so

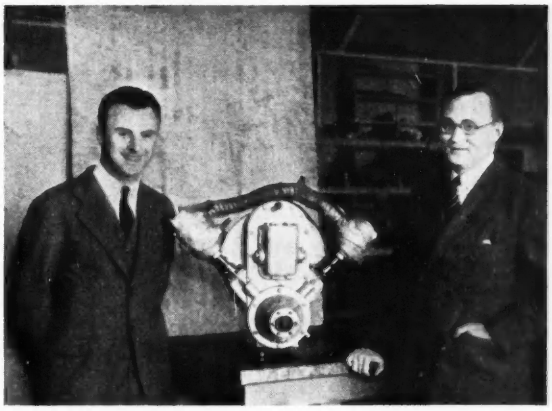
that very little water is lost, and ten gallons are sufficient for an ordinary flight under reasonably cool weather conditions. To start the boiler it is merely necessary to press a switch which starts an electric blower motor, causing air and fuel to be forced through the burner and into the boiler, where ignition is effected by spark. From then on the automatic controls operate all the necessary functions, and the pilot has only to move the throttle and reverse lever, there being one position for forward and one for reverse.

Several years of laboratory work preceded the actual flight, during which period several engines and steam generators were developed. When the power plant was finally installed in the aeroplane it had already run some thirty hours on the dynamometer and after installation in the fuselage it was operated for about twenty hours more. All of its characteristics were well known, and flight was to all practical purposes a foregone conclusion. Furthermore, prior to dismantling the original power plant, the aeroplane was carefully weighed and measured by students in the Boeing School of Aeronautics, the centre of gravity being exactly located for all conditions of loading, to insure that as close a comparison as possible could be obtained between the original Curtiss engine and the new steam installation. When the aeroplane was re-erected it was checked to determine its conformity to the previous figures, and the hub of the same propeller used with the petrol engine was modified to fit the new steam engine.

A report on Mr. Besler's pioneer flight was made for



The steam-power unit as fitted to the aeroplane, the boiler on the left and the steam engine on the right.



Mr. William (left) and Mr. George Besler, with the special steam engine for use in aircraft.

Aero Digest by Mr. A. F. Bonnalie, head of the Boeing School of Aeronautics, one of the largest flying services in the United States. He points out that the first flights, while short, were extremely impressive.

From the time the fires were started until the engine was run up, not more than five minutes elapsed. A little time was taken further to test out the reverse gear and to be sure that all apparatus was operating correctly; then the plane taxied down the field into position for the take-off. The take-off was normal in every respect except that the absence of noise was noticeable. In fact when the plane left the ground, it was the observer's impression that the machine was not getting up sufficient speed. It flew strongly, however, and circled overhead a couple of times. When under full power no more noise was noticeable than is apparent with an aeroplane gliding with the engine off—merely the swish of the air could be heard. Even when operating on the ground at full throttle, the propeller made very little noise.

While the first flights were made at low altitude, the climbing angle was noticeably steep and the aeroplane was obviously under full control of the pilot. As he approached for a landing and crossed the border of the field, the propeller rotation ceased, and backward rotation slowly started. After touching the ground the pilot gave it full reverse throttle, which, together with the brakes fitted to this particular aeroplane, brought it to a stop very quickly. Mr. Besler again took off and after a short flight simulated a forced landing, then took off once more round the field and landed again with a short run. Being satisfied with the preliminary tests, the proprietors propose to give more extensive demonstrations and to make quantitative tests.

Wireless Waves to Kill Insect Pests.

The control of insect pests is increasingly being studied in this country and in America. In "The Scientific American," a contributor describes recent tests in which wireless waves have been used to treat infested crops.

THE use of high-frequency current for medical purposes was first proposed as long ago as 1891. Experiments on human beings and animals with high-frequency waves were later conducted, and it was found that these currents acted energetically on the vitality of the tissue. In 1927 it was observed that workmen testing wireless equipment experienced an elevation of body temperature, and it was demonstrated that this could be applied to the production in animals of any degree of fever at will. Short waves for the production of artificial fever are now being used in several hospitals. In an article in the *Scientific American*, Mr. J. H. Davis, an engineer, describes how these experiments suggested to him the possibility of using short waves in the extermination of insect pests in all stages of their development from the egg to the adult. He was prompted to pursue this study, since it is generally recognized that more effective means than those at present available are needed to reach and kill the eggs, larvae and pupae which may be concealed within the host material.

Mr. Davis points out that to mitigate the depredation of insects in stored grain it is customary to withdraw it from time to time for "airing and cooling." The development of the eggs and larval forms within the material is temporarily arrested by exposure to cold air, but when the temperature of the stored material is again elevated, due to respiration or other causes, the eggs are hatched and a new generation of pests necessitates repeating the cooling and airing operation.

New Developments.

If the infested material is given a "killing dose" of high-capacity high-frequency electrical oscillations and re-infestation is prevented by proper storage and aeration, the product can be kept for long periods of time. Recent developments in the field of short-wave treatment and proper aeration, including the maintenance of proper temperature and humidity conditions, appear to make this possible. Records are available showing that two million bushels of wheat in storage for a period of about two years were withdrawn for cooling and airing thirteen times, resulting in a loss equivalent to about 130,000 bushels, or one half of one per cent for each withdrawal.

Certain species of weevils, writes Mr. Davis, drill holes in the grains in which their eggs are deposited and the holes are so cleverly sealed that ordinary methods of inspection fail to reveal infested kernels. Within three or four weeks, under favourable temperature conditions, these eggs will hatch. The growing insect consumes the inside of the grain and thus destroys it for useful purposes.

The author recently carried out some preliminary tests on small quantities of infested wheat to discover whether radio methods could be effectively used to exterminate the eggs and larval forms which may be concealed within the material, as well as the adult insects. Thirty- and six-meter waves were used, the former of low capacity and the latter of high capacity. The thirty-meter low capacity waves were effective in exterminating adult insects in small quantities of wheat within a period of about ninety seconds, but the eggs later hatched out. With the six-meter waves an exposure of six seconds was sufficient to exterminate eggs, larvae, and adults.

Testing Infested Grain.

The writer then installed a plant for the purpose of making a comprehensive series of tests on infested grain. The plant has been in operation for a year, and many kinds of infested materials have been successfully treated, including wheat, corn, flower and garden seeds, tobacco, spices, nuts, beans, peas, cocoa beans, packaged and bulk milled cereals, and so on.

Hundreds of tests have been made, using infested materials of various kinds and under various conditions. Mr. Davis states that the results of the tests indicate definitely that weevils in all stages of their development, from egg to adult, can be exterminated without injury to the germinating properties of grain, or appreciably affecting the moisture content, and without adversely affecting the food value. There are indications that the germinating properties of wheat and other seeds treated may be enhanced. Worms, mites, and other infestations of cocoa beans, spices, tobacco, nuts, packaged cereals, and so on, can be exterminated without injury to the products treated. Where the equipment is properly installed there are no adverse effects upon persons working or stationed in the vicinity of the apparatus.

Apart from the fact that temperatures lethal to animal life can be obtained, under proper conditions, without the necessity for elevating the host materials to such temperatures, there may be other factors contributing to the destruction of animal life in the stored grain, such as the effect of invisible light or other rays.

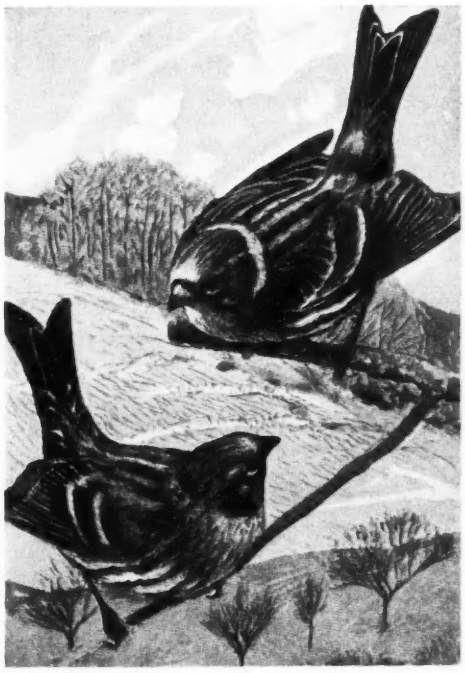
A Bird Watcher in France.

By E. W. Hendy.
(*Author of "The Lure of Bird Watching," etc.*)

Important observations in France of birds which are unknown or rare in Great Britain are recorded in a new book by a distinguished French watcher. Other aspects of common interest in both countries are discussed, such as the question of whether swifts remain in the air all night.

THOSE who enjoyed M. Jacques Delamain's book "Why Birds Sing"*—and they are many—will welcome his second volume, which is at present available only in French†; but to anyone who has a fair knowledge of that language this is not a disadvantage, for the author's prose flows smoothly, and it possesses a clarity which is difficult to reproduce in English.

In writing of the birds of his native Charente, M. Delamain describes their environment very charmingly. The first four sections "nuit d'hiver," "nuit de printemps," "nuit d'été," and nuit d'automne" give vivid pictures of the countryside at those seasons, as well as of its avian inhabitants. The chapter "la vigne et l'oiseau" leads the reader through the vineyards which produce cognac, "belle liqueur dorée": M. Delamain makes us smell the scent of the vine flower—like new-mown hay of the mingled perfume of mignonette and lime blossom—and incidentally tells us much of interest about vine culture. His landscapes recall Corot and his vignettes of birds remind us of Bewick's woodcuts.



Serin finch, from a water colour by Leo Pol Robert, the Swiss artist.

Many of the species which he describes are well known to British ornithologists, though in some cases they are, no doubt, the Continental varieties. Nevertheless the rouge-gorge and the traîne-buisson, for instance, have the same engaging habits in the Charente as our English robin and dunnock. Reading his pages it is easy to imagine ourselves in England rather than in a foreign and more southerly country where the climate is usually milder. "Usually," for in "nuit d'hiver" M. Delamain gives a graphic account of how a hard winter will decimate the bird population even in those more favoured latitudes. But it is at first surprising to a home-keeping field naturalist to find the crested tit and the Dartford warbler ("pitchou provençal") haunting the heaths and pinewoods of southern France.

M. Delamain gives a very interesting account of "le serin méridional ou cini." This charming little bird has for some centuries been spreading northwards. Indigenous in northern Africa and Provence, by 1550 it had reached the Rhone Valley and Gascony. For the next two hundred years it seems to have remained stationary, but by 1931, pushing forward its right and left wings alternatively, it had arrived in Belgium, northern France and Britanny. M. Delamain predicts its invasion of Great Britain. Ornithological pundits admit some thirty records of this bird in this country, mostly from the southern and eastern counties. His account of its passionate song, its courtship, its delicate nest, strengthened with spiders' webs, which you can hold in the hollow of your hand, and its other delightful habits, make us hope that his prophecy will come true.

As he says, there are certain species which seem to have a tendency to extend their range, the nightingale towards the north of England (and, we may add, towards the west, for of late years it has established itself as a breeding species in Devonshire), and the fieldfare towards the east. The serin, with its sturdy

* See *Discovery*, September, 1932.

† *Les Jours et Les Nuits des Oiseaux*. By JACQUES DELAMAIN. (Librairie Stock. 15 fr.)

constitution, inconspicuous plumage and catholic seed diet, seems peculiarly well equipped to conquer new territory. But, so far, our knowledge of the fluctuations in the life history of most species is too limited to enable us to predict their future.

The chapter on " les nids " is full of sympathetic observation and suggestive thought. It is not till, in the ascending scale of life, we reach the birds (says M. Delamain) that we find " la tendresse maternal et les soins passionnés prodigués par un couple de parents," though the Archeopteryx of old, like the Megapode in our own times, had not risen so high. Nests vary in the fineness and complexity of their architecture between the scrape of the lapwing and the intricately woven sphere of the long-tailed tit, or the thatched tenement-nurseries of the sociable grosbeak. The age-long experience of the species decides the type, but individual intelligence plays its part ; witness the herons which, in treeless districts, build their nests upon the cliffs. Does this originality lead on some entire species (and perhaps individuals in others) to an aesthetic sense ? There is the bower-bird, with its gaily decked booths. M. Delamain quotes many curious instances of decorated nests, e.g., the gull which adorned the outside of its nursery with wild blue hyacinths, and the moorhen whose taste in nesting material included red anemones. In courtship male birds charm their mates with the radiant glories of their plumage. It is at least reasonable to suppose that in the succeeding stage, that of nest-building, birds are not insensible to beauty.

Writing of " oiseaux de mon pays," M. Delamain introduces us to some birds of the Charente which are unknown or rare in Great Britain. The ortolan arrives when the vine has " debourré " (broken the bud) ; there is the Orphean warbler, the most beautiful and wildest of that family ; the melodious warbler, whose French name, " polyglotte," denotes its varied song ; the woodchat and lesser grey shrikes, perching on the telegraph wires ; the serin ; the little bustard, whose nuptial display reminds us of that of the ruff ; the harriers (marsh, Montagu's and hen) ; the short-toed lark, whose protective colouring makes him almost invisible on sandy soil ; the great reed and Cetti's warblers, loud and arrogant in song. Hoopoes and golden orioles are common. Evidently a country rich in bird life, though the birds are wilder than with us, for the " chasseur " has taught them that " il n'est pas bon de laisser l'homme approcher de trop près."

The chapter entitled " histoire d'une famille de martins-pêcheurs " is a charmingly written account of kingfishers. M. Delamain has watched them from the return to the nesting-hole in the sandpit—a somewhat unusual site—to the time when the parents drive off the young of the first brood before they begin to rear the second. (In England the species is usually single-brooded.) The chapter is a model of accurate observation and aesthetic appreciation.

" Les oiseaux des fils electriques " is a section in which the author follows the network of electric wires with which France, like modern England, seems to be encumbered, across country to the town, and tells of the birds which use them for perches—an original idea which might well be copied by some bird-watcher here.

Crossbills invaded the Charente in 1930 and attacked the apples, no doubt because the coniferous trees were not numerous enough to supply their usual food. The reason for these occasional irruptions is obscure : probably, as M. Delamain says, it was a question of excess population and shortage of food in their native pinewoods. As in England, a few couples remain for a year or two, and then we see them no more till the next invasion. Whether swifts remain in the air all night has often been debated. M. Delamain quotes the case of an aviator who encountered the birds at 3,000 feet on a moonlight night and found a dead swift in the body of his machine in the morning.

This book will serve to sustain M. Delamain's reputation. It is gratifying to find that France possesses so good an observer. The book can safely be recommended to all bird-lovers.

Man and the Balance of Nature.

THE fact that the interference of man with the balance of nature had almost always brought evil in its train was emphasized in a recent address by Professor E. J. Salisbury, F.R.S. Some idea, he said, of the ease with which seeds and fruits were unconsciously conveyed by man might be obtained by germinating the seed from the mud upon one's boots after a country walk. The carriage of seeds on clothing was as effective now as in the past, and must have been important even in the time of primitive man. Though clothing would have been more scanty in those days, it was free from the attentions of the clothes brush. We were not in a position to know in what quantities primitive man actually conveyed seeds, but some idea of the potentialities of such carriage could be obtained from a study of trouser-brushings of the present day. The seeds which found lodgment in the turned-up edge might be regarded as fair samples of those which would reach the surface of any itinerant human being, however garbed.

Safer Flying in the Autogiro.

One of the aviator's chief problems is the fact that an aeroplane cannot remain safely in flight except when travelling at a relatively high speed. The latest autogiro demonstrated at the London Airport offers a solution to this difficulty.

SOME years before the war both the aeroplane and the airship had already attained relatively creditable performances. Although the war years saw vast developments in construction and design, the general principles of flight have remained basically the same. A few years ago, however, a new flying machine was evolved, which is based on entirely new principles of flight and is likely to extend the whole scope of aviation in a remarkable way. Designers of orthodox aeroplanes have hitherto been faced with one apparently insurmountable problem. A normal aeroplane wing derives its lift from its forward motion through the air: there is a definite minimum air speed at which the wing ceases to lift and the aeroplane ceases to fly, dropping or "stalling" in the air. Many devices have been invented to minimise the effect of stalling and to increase the lateral control of a wing in the stalled condition. But although great improvements by the use of slots have been achieved, it remains a fact that a fixed wing will always stall with sufficient loss of forward speed.

The latest British autogiro without wings.

Some years ago Señor Juan de la Ciĕrva, a Spanish aeronautical engineer, constructed a twin-engine military machine, built to the latest requirements of orthodox design; this aircraft, although excellent in construction, was wrecked by its pilot through an error of judgment; while in the air the machine lost flying speed, stalled and crashed. This accident convinced Señor de la Ciĕrva that there was something definitely lacking in aeroplane performance, and that in order to secure a wider usefulness for aircraft a machine must be built that could fly with perfect safety without the necessity of maintaining a high air speed. He thus determined to solve the problem of safe, slow flight; and it is to his perseverance and mechanical skill that we owe the autogiro, or automatic rotating-wing aircraft.

In studying the problem of flight of the heavier-than-air machine, Señor de la Ciĕrva decided that in order to achieve safe slow flight, some entirely new form of lift medium was required: the normal fixed wing with its definite limits would not do. He therefore decided that he would employ some form of wing or lifting surface that would be in constant motion to the air, but that this motion must be independent of the forward speed of the aircraft itself. Freely rotating wings or rotors, attached to a central pylon structure fitted to the aircraft body, was the final solution. (This system must not be confused with the heliocopter, where horizontal air screws above the fuselage are coupled direct to the engine and are intended to lift the machine vertically from the ground.)

Several experimental machines were constructed on the autogiro principle without great practical success, until it was discovered that the secret of flight with rotating wings lay in allowing the rotor blades a certain free movement in all directions. A machine was constructed embodying this theory, and successful flight was achieved. Following the success of the early autogiros, various governments became interested and companies were formed in England and America to sponsor and develop the machines. Developments have proceeded rapidly during the last few years and great advances have taken place. To-day, the Ciĕrva autogiro holds the full British Air Ministry certificate of airworthiness, the hallmark of modern aircraft.

In 1932, the standard British autogiro was the C. 19, an open two-seater that has flown many thousands of

miles in all weathers and climatic conditions. This machine has a 100 h.p. engine and a three-bladed rotor system, the blades of which fold for easy storage. The rotors, which rotate freely and independently of the engine, are set in motion in the first instance by a clutch. The clutch is engaged with the engine to start the rotors, and when the requisite revolutions are obtained, the clutch is disengaged and the autogiro takes off in the usual way.

The C. 19 has small wings to carry the ailerons for lateral control and a tail unit comprising the normal rudder and elevators is fitted. The pilot controls the machine when in the air in exactly the same way as he would an aeroplane. The autogiro will take-off in about thirty yards, climb steeply, has a forward speed range of from 20 to 100 m.p.h. and will descend vertically and land without forward run. The machine does not stall or spin ; in fact, when the control stick is pulled right back with the engine shut off, the craft simply descends in a nearly vertical path. The wheel and brakes are fitted for easy control on the ground.

Señor de la Cierva's latest research has convinced him that perfect flying control direct through the rotor itself can be achieved, and he has therefore constructed an experimental machine without the stub-wings, ailerons, rudder and elevator. Experiments were so successful that after further work, the latest model incorporating direct control has been produced. This is the C. 30, which represents the latest development in aircraft. All orthodox flying controls have been eliminated and one flying control only is used, a central hanging stick direct from the rotor hub. The pilot simply moves this stick, which in turn tilts the rotor assembly and positive control of the flight path is secured in any direction.

The C. 30, without fixed wings and with only small fixed tail surfaces for directional stability, thus has a greatly improved performance. It will take-off in six or seven yards in still air, climb at a remarkable angle, and land, as an autogiro should, with no run at all. The speed ranges from 12 m.p.h. to over 100 m.p.h. When the visibility is bad, instead of being obliged to fly at 55-60 m.p.h. through fear of stalling, the pilot can slow down in the air and proceed with caution even at a low altitude. Should engine trouble develop, he can land without forward run and consequent danger in a small field, and can descend safely over tall obstacles. What future developments can we expect? It is difficult to foretell the possibilities open to the aircraft borne on rotating wings. Already autogiros with 500 h.p. engines have been flying successfully in America, and plans for a British machine to carry six persons are now complete, while larger autogiros still are to be built.

Einstein and Theoretical Physics.

The " eternal antithesis " between experience and reason in the sphere of physics was discussed by Professor Einstein in a lecture last month at Oxford. If, he asked, experience is the beginning and end of our knowledge about reality, what rôle is there left for reason in science ? The following are extracts from this important address.

If you wish to learn from the theoretical physicist anything about the methods which he uses, I would give you the following piece of advice : do not listen to his words ; examine his achievements. For to the discoverer in that field, the constructions of his imagination appear so necessary and so natural that he is apt to treat them not as the creations of his thoughts but as given realities.

The scientist's view of the past and present history of his subject is likely to be unduly influenced by what he expects from the future and what he is trying to realize to-day. But this is the common fate of all who have adopted a world of ideas as their dwelling-place. He is in just the same plight as the historian, who also, even though unconsciously, disposes events of the past around ideals that he has formed about human society. I want to glance at the development of the theoretical method, and while doing so especially to observe the relation of pure theory to the whole data of experience. Here is the eternal antithesis of the two inseparable constituents of human knowledge, experience and reason, within the sphere of physics. We honour ancient Greece as the cradle of western science. She for the first time created the intellectual miracle of a logical system, the assertions of which followed one from another with such rigour that not one of the demonstrated propositions admitted of the slightest doubt—Euclid's geometry.

This marvellous accomplishment of reason gave to the human spirit the confidence it needed for its future achievements. The man who was not enthralled in youth by this work was not born to be a scientific theorist. But the time for a science that could comprehend reality was not ripe until a second elementary truth had been realized, which only became the common property of philosophers after Kepler and Galileo. Pure logical thinking can give us no knowledge whatsoever of the world of experience ;

all knowledge about reality begins with experience and terminates in it.

Conclusions obtained by purely rational processes are, so far as reality is concerned, entirely empty. It was because he recognized this, and especially because he impressed it upon the scientific world, that Galileo became the father of modern physics and in fact of the whole of modern natural science. But if experience is the beginning and end of all our knowledge about reality, what rôle is there left for reason in science? A complete system of theoretical physics consists of concepts and basic laws to inter-relate those concepts and of consequences to be derived by logical deduction. It is these consequences to which our particular experiences are to correspond, and it is the logical derivation of them which in a purely theoretical work occupies by far the greater part of the book.

Reason gives the structure to the system of theoretical physics; the data of experience and their mutual relations are to correspond exactly to consequences in the theory. On the possibility alone of such a correspondence rest the value and the justification of the whole system, and especially of its fundamental concepts and basic laws. But for this, these latter would simply be free inventions of the human mind which would admit of no *a priori* justification either through the nature of the human mind or in any other way at all.

Newton, the first creator of a comprehensive and workable system of theoretical physics, still believed that the basic concepts and laws of his system could be derived from experience; his phrase "hypotheses non fingo" can only be interpreted in this sense. In fact, at that time it seemed that there was no problematical element in the concepts, space and time. The concepts of mass, acceleration and force, and the laws connecting them, appeared to be directly borrowed from experience. But if this basis is assumed, the expression for the force of gravity seems to be derivable from experience; and the same derivability was to be anticipated for the other forces.

Absolute Space.

One can see from the way he formulated his views that Newton felt by no means comfortable about the concept of absolute space, which embodied that of absolute rest; for he was alive to the fact that nothing in experience seemed to correspond to this latter concept. He also felt uneasy about the introduction of action at a distance. But the enormous practical success of his theory may well have prevented him and the physicists of the eighteenth and nineteenth centuries from recognizing the fictitious character of the principles of his system.

On the contrary, the scientists of those times were for the most part convinced that the basic concepts and laws of physics were not in a logical sense free inventions of the human mind, but rather that they were derivable by a logical process from experiments. It was the general Theory of Relativity which showed in a convincing manner the incorrectness of this view. For this theory revealed that it was possible for us, using basic principles very far removed from those of Newton, to do justice to the entire range of the data of experience in a manner even more complete and satisfactory than was possible with Newton's principles.

But quite apart from the question of comparative merits, the fictitious character of the principles is made quite obvious by the fact that it is possible to exhibit two essentially different bases, each of which in its consequences leads to a large measure of agreement with experience. This indicates that any attempt logically to derive the basic concepts and laws of mechanics from the ultimate data of experience is doomed to failure.

The Correct Way.

If, then, it is the case that the axiomatic basis of theoretical physics cannot be an inference from experience, but must be free invention, have we any right to hope that we shall find the correct way? Still more—does this correct approach exist at all, save in our imagination? Have we any right to hope that experience will guide us aright, when there are theories (like classical mechanics) which agree with experience to a very great extent, even without comprehending the subject in its depths? To this I answer with complete assurance, that in my opinion there is *the* correct path and, moreover, that it is in our power to find it. Our experience up to date justifies us in feeling sure that in Nature is actualized the ideal of mathematical simplicity.

It is my conviction that pure mathematical construction enables us to discover the concepts and the laws connecting them which give us the key to the understanding of the phenomena of Nature. Experience can of course guide us in our choice of serviceable mathematical concepts; it cannot possibly be the source from which they are derived; experience of course remains the sole criterion of the serviceability of a mathematical construction for physics, but the truly creative principle resides in mathematics. In a certain sense, therefore, I hold it to be true that pure thought is competent to comprehend the real, as the ancients dreamed.

Excavating the Biblical City of Lachish.

By E. N. Fallaize.

Excavations at Tell Duweir in Southern Palestine tentatively identify the site with the Biblical city of Lachish. This account of the first season's work is based on the reports of Mr. J. L. Starkey, the director. For access to the reports and for the illustrations we are indebted to Sir Charles Marston.

DURING the past season, 1932-33, the Wellcome-Colt Archaeological Expedition under Mr. J. L. Starkey, has been engaged in the excavation of Tell Duweir, in Southern Palestine. The site is about twenty-five miles south-west of Jerusalem and twenty-three miles north-east of Gaza, the sea lying twenty miles to the west. The top of the Tell is about 900 feet above sea level and its mean height above ground level is 130 feet. The area of the mound at the base is thirty-nine acres and at the summit about twenty-three acres. Its commanding position, looking out over the plains of Philistia and its strong fortifications, of which the remains were still to be seen at the top of the Tell before the present excavation, made this in ancient times a place of great strength and strategic importance. This fact lends strong support to its identification with the scriptural city of Lachish, which offered a more strenuous resistance to Joshua than any other city in Palestine and was twice captured subsequently, once by Sannacherib—a representation of this siege is shown on a carved relief from Nineveh now in the British Museum—and by Nebuchadnezzar. It was indeed, partly in the hope of finding evidence which would confirm this identification and corroborate the Biblical story of Lachish that Tell Duweir was selected for excavation by this expedition.

A preliminary reconnaissance in the preceding year had suggested the main line of attack and had held out strong hope that excavation would be productive of a rich harvest by the large number of surface-finds of pottery, of which the styles pointed to an occupation going well back into the Bronze Age. It was determined to begin operations on the north-western corner of the mound, above which stands the great stone building at the top of the mound, working inward and upward from the base.

The work began early in December, after some weeks had been spent by members of the expedition in necessary preliminaries, such as settling details with the authorities at Jerusalem and the local peasantry, in making arrangements for labour and erecting accommodation for the members of the expedition and the storage of archaeological material. It was first necessary, however, to provide a dumping ground for the earth from the excavation. For this purpose it was determined to clear an area on the north-west side of the mound and build retaining walls to form high terraces which would be available for future cultivation by the villagers. Here the fortune which gives fascination to an excavator's work, if at times it brings irritation and disappointment, intervened. This clearance, which was undertaken as part of the organization of excavation, proved to be the longest and most expensive operation of the season. It was not completed until the end of March, by which time one and a quarter acres had been added to the land available for cultivation, but, a compensation more satisfactory from the point of view of the archaeologist, it had yielded a mass of datable material which will be of the greatest value at a later stage of the excavation in elucidating the history of the site.

Clearing a well at the north-east corner of Tell, showing how the buckets are lowered over pulleys suspended from scaffolding.

The first indication of what was to come was the discovery of ancient cuttings when clearing down to bed rock to mark the line of the retaining wall. The first of these cuttings proved to be an ancient well, choked with boulders, which when cleared—a lengthy and difficult operation—was proved by the sherds found in the filling to be of Middle Bronze Age date. Other cuttings

were found to be rock-cut chambers, tombs which contained potsherds of Iron Age date. The clearance was ultimately carried up to the cliff, where it was found that the inhabitants of the fortress had cut back the rock to a vertical face, rendering this side well-nigh impregnable, while before it was a fosse, carefully cut in the rock, running north-east and south-west, and following the line of the rock-platform on which the mound stands. This fosse was of considerable depth, the lowest deposits being found at thirty-eight feet below the present surface. A cache at the lower levels of the fosse, with pottery showing as a decoration a metope with a bird, similar to pottery found at Tell el Ajjul, afforded a welcome dating to the last phase of the Middle Bronze Age or Hyksos period.

A view across the southern portico showing fallen column drums and large base thrown over the pit.

Foundations of houses as well as tomb chambers were discovered in this area, some coming down to as late as early Christian times. The siting of those belonging to the later Jewish kingdom indicated that the contours of the mound had not changed in any great degree since the abandonment of the city. Among the relics found in the foundations of houses belonging in date to the XIXth dynasty was a sherd of late Mycenaean pottery which may be dated at about 1260 B.C. The numerous tombs, like the houses, varied considerable in date. In one instance the inhabitants of a Solomonic house had broken into an earlier tomb and had made use of it, cutting a staircase from the back wall of the house down into the tomb. The most important of the tomb-chambers was contemporary with the eighteenth dynasty of Egypt. One tomb chamber yielded a quantity of pottery of various types with a number of other articles, such as scarabs, bronze rings, alabaster vases, etc. The pottery types provided links between those discovered at Jericho and Tell el Ajjul. It is therefore concluded that this tomb belongs to the early Hyksos period and precedes by some considerable time the attack by Joshua.

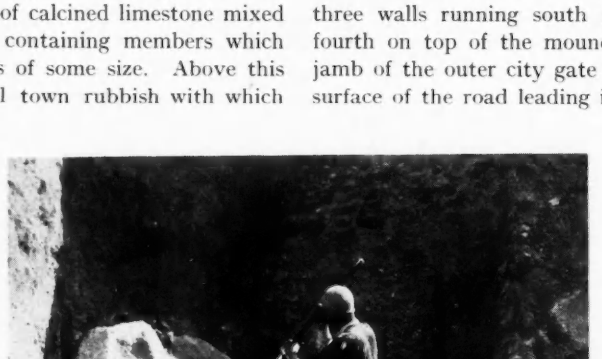
The number of small finds from this clearance area was considerable, and in addition to pottery of the Bronze and Iron Ages, includes figurines of Astarte of conventional type, scarabs of steatite (some of very fine workmanship though of local origin), of green jasper and of rock-crystal, vases of alabaster and serpentine, bronze daggers and rings, beads, etc. Of human skeletal remains a large number were found. Of these some, in a sufficiently good state of preservation, are being sent to England for anthropological examination.

The largest amount of pottery, however, from an individual deposit, did not come from this cleared ground, but from a cemetery area at the back of the camp, which was accidentally discovered by a workman while digging clay for plaster. From this large deposit seven hundred specimens have been taken and it is not yet completely cleared. The pottery forms a homogeneous group of late Solomonic age, covering from about 850 B.C. to about 575 B.C. There appears to be no cultural break at the Exile, and this would support the view that the percentage of Jews deported by Nebuchadnezzar was small.

Important as the work on the area of clearance proved to be, it was only a preliminary to the main objective of the excavation, the examination of the fortifications and building which crown the Tell. The work of unmasking the great stone revetment which runs round the mound below the summit was begun on December 17th. The earth was then removed at the north-east corner of the work down to bed rock. This revealed eleven courses of dry-walling, of excellent workmanship, totalling twenty feet in height. The work of uncovering the revetment was continued at various points and by the end of the season all four corners of the work had been examined. The various methods followed in turning the four corners, each distinct, proved of no little interest. At the north-west corner a bold sweeping curve was supported by five buttresses, the intervals between them being filled in by large pieces of limestone and a mass of lime plaster which formed a solid matrix, a feature unique in Palestinian architecture.

The stratification of the material removed in

uncovering the face of the revetment afforded a valuable clue in tracing the history of the city, when supplemented by the evidence afforded later in the examination of the city walls. At the base of the revetment was a mass of marl lying on bed rock and covering the lower courses of the dry walling. It contained a number of small pottery fragments, some being as late as Middle Iron Age. It was evidently intended to protect the footing of the wall from damage by rain-water drainage. Overlying this was a white stratum, consisting of calcined limestone mixed with charcoal, the latter containing members which had once been tree-trunks of some size. Above this was a deposit of the usual town rubbish with which were fragments of masonry from the upper courses of the revetment and possibly from the city wall above.



A Fellah drilling a large limestone block before splitting it with gunpowder.

It is evident that the material of the second stratum is the result of a considerable conflagration, of which further evidence was obtained at various points. When the city walls came to be examined, they showed the marks of having been breached in several places and afterwards repaired, not too skilfully. It is reasonable to conclude that these breaches were made in the course of the attack on the city by Sennacherib, tentatively dated at 701 B.C., when, as shown in the British Museum relief, battering rams were used. Subsequently to their repair the walls were completely destroyed by fire. In the stratum of calcined stone and charcoal we may see evidence of the destruction of the city by Nebuchadnezzar at about 586 B.C. It would appear that his army cut down the trees from the neighbouring hills and olive groves, and piling the trunks against the wall, set fire to the whole. The olive stones found in this stratum point to the siege having taken place in the month of July or August. Further evidence of the disastrous character of this conflagration was afforded in the course of the examination of the bastion and gateway at the south-western corner of the fortress. Here there was also evidence of one, and possibly two earlier assaults, in which the defences had suffered severely, and the damage, as elsewhere, had been indifferently repaired.

The work of clearing the bastion, a square tower projecting from the main line of fortification, was rendered difficult by the character of the debris; the great blocks of the drywalling demanded the greatest care in removal and at the same time made it difficult to follow the line of the walls with certainty, owing to the absence of binding material. Eventually three walls running south from the bastion with a fourth on top of the mound were traced. The left jamb of the outer city gate had disappeared, but the surface of the road leading into the city was brought to light. It was carried up to the gate by a ramp of earth supported by the oldest of the three walls, of Middle Bronze Age date, while the second wall had served as a flanking wall to the road, which here was from twenty to twenty-five feet wide. Flanking towers in the city walls adjoined the inner of the two city gates added to the strength of the defences, while the conjecture that a room abutting on the base of one of the towers had served as a guard room was supported by the discovery of iron lance-heads. Near one of the walls leading to the bastion under débris was a bronze crest-mount of a helmet, similar to those worn by soldiers in the British Museum relief.

A cross section of the city walls in this area on the west side provided the solution of an intriguing problem which had cropped up on more than one occasion in the course of the excavations. This was the occurrence of burnt brick in ballast and debris as well as traces of what had appeared to be a burnt brick building, surmounted by the remains of a tower connected with the revetment at the north-east corner of the Tell. It was now made apparent that walls of unburnt mud brick of a very substantial character lay below the late city walls.

It is necessary to pass over other features in order to deal (too briefly in proportion to its interest) with

the examination of the great building on top of the Tell, covering an area of 8,400 square feet, which made Duweir unique as a surface site in Palestine.

Although it was not possible from the surface indications to gauge the date or purpose of the building, it was evidently the central and most imposing structure of the city and might well have been a palace. The work of clearance, however, had not proceeded far when it began to appear that here was not one structure but two, a later superimposed upon an earlier. The latter had been destroyed and levelled so that the second might be erected upon it, as on an elevated platform. The second building being smaller than the first, the platform projects as a terrace at north and south, nor do its walls follow the lines of the earlier building or have any relation to them. Its size, and the number and character of its rooms, public, domestic and offices, make it imposing enough to have been the residency of a governor. With the exception of a space which must have served as an open court, the rooms had been roofed over; for the room-spaces were filled with limestone blocks, of which the curvature in a number showed that they had formed part of a barrel-roofing. Protodoric columns, of which the bases are to be seen with the broken shaft nearby, unfortunately lack their capitals, though there is hope that these may be recovered at a future date. The building is probably of the fourth to fifth century B.C.

A view of the upper city wall looking south from the inner gate of the city.

It has not been possible to refer in detail to all the investigations which were made at various points of the mound. Enough has been said, however, to indicate the satisfactory results of the excavation and to show that an excellent beginning has been made in elucidating the history of an interesting and undoubtedly important site. Especially does it hold out promise of contributing materially to knowledge of a little-known period of the prehistory of Southern Palestine, when the levels contemporary with and earler than the brick walls underneath the stone walls of the city are examined. At the present stage of the investigation it is not possible to arrive with certainty at any conclusion as to the chronological range which the excavation is likely to cover; but it may be mentioned that evidence has been gathered which proceeds in unbroken order from the Early Bronze Age to the period of the latest occupation of the city.

A bird's-eye view of the cultural and chronological sequence is given by a section of the town levels at the north-western corner of the Tell, made towards the close of the season's excavations. A cutting was made into the surface of the mound in two stages, each nineteen feet deep, which thus gave a total depth of thirty-eight feet over the native rock. It was found that the first ten feet were all early Canaanite, dating back certainly into the third millennium B.C. The upper twenty-eight feet represented the Hyksos, Middle and Late Bronze Ages, the last-named being contemporary with the nineteenth dynasty of Egypt. At this point, however, the upper and later levels of the city were not clearly represented, and to complete the picture the upper ten feet of the town levels behind the line of the city wall in the western cutting were worked stratigraphically. A complete and continuous series of potsherds was obtained from ascertained levels, ranging from the latest occupation of the city back to the earliest phase in the lowest deposits, where the existence was proved of deposits belonging to the little-known early cultural period of Southern Palestine.

In the early levels of these cuttings were found wares which are still almost unknown. So far in Palestine they have been found only in the Jordan valley. They have a beautiful black burnish, and show affinities on the one hand with the products of the muffled technique of predynastic Egypt, and on the other with the pottery of the early Cypriote Bronze Age. In Palestine they point, apparently, to the existence of a new cultural phase which overlaps the already known Early Bronze culture. A selection of the material found will be shown at an exhibition in London next month.

Book Reviews.

The Universe of Light. By Sir WILLIAM BRAGG. (Bell. 12*s.* 6*d.*).

Sir William Bragg tends towards the ideal popular expositor of science, not because he attempts to explain in " words of one syllable " the science which he understands so well, not because he tries to make things plain by leaving out essential facts which are difficult, but because he takes immense pains in the presentation of his work. Telling phrase, happy analogy, lucid statement, apt photographs, clear diagrams, all go to make his new book " understanded of the people." The reader gets the clear impression that the book has an author who is neither patronizing him nor playing down to him, but, instead, doing all he can with words and pictures to make subjects admittedly difficult as plain as can be. The book is an expansion of the Christmas lectures which the author gave to an audience of children at the Royal Institution in 1931. The children saw there what they will rarely see later in life in school lessons or university lectures —a set of lectures illustrated by numerous experiments, admirably designed and perfectly carried out, which reinforced the spoken word in a way that would be remembered. In the book these are replaced by photographs, diagrams, drawings in wash and coloured plates; they have been arranged as to be the best substitute for the demonstrations themselves.

The author uses the word " light " in the broad sense of radiation—radiation which varies in wave-lengths from the energy which gives us broadcasting to that which as X-rays and gamma-rays reveals to us the beauty and the wonder of crystal structure; actual, obvious, visible light, however, is very naturally the chief subject. The book begins with an account of the nature of light and of the function of our eyes in vision. Then come three beautifully illustrated chapters on colour. The strange and difficult subject of the polarization of light is lucidly described. The reader is next told how radiation has enabled man to unlock the secrets of the stars and distant nebulae at one end of the scale of creation and of crystals, molecules, and atoms at the other. Throughout the book the historical development of the subject is carefully traced, especially with regard to the rising and waning in popularity at different periods of the two opposed theories of radiation—the corpuscular theory which Newton put forward, and the wave-theory of Huyghens. Physicists to-day, as is well known, have been compelled to accept in part both of these theories, despite their mutual exclusiveness, in order to find simple interpretations of what the experiments reveal. This paradox is the subject of the last chapter. It is very interesting but it need not, Sir William assures us, worry us overmuch. " If there are contradictions which perplex us they must be due to imperfections in our theories and illustrations; and we need not strain overmuch to resolve them. The resolution will come in its own time, when research has added to our knowledge and lifted our minds to higher points of view." Much of the trouble here is due to the fact that scientists think they are reasoning about radiation whereas they are in fact only reasoning about the results of their experiments on radiation. Light sometimes behaves like waves, sometimes like particles, and, until they are able to imagine some common object which is sometimes like waves and sometimes like particles, the true nature of light lies beyond their ken. Possible it may do so for ever. But they can and do represent it most successfully by symbols.

Everywhere in the book there is freshness and vigour in exposition. It may be argued that it is only the old stuff with variations but it is Sir William who has done the variations. Thus, who before in describing the time-honoured optical illusions of parallel lines which appear to be convergent, or of lines of equal length which have been made to appear dissimilar, has pointed out that one of the reasons for the illusion is that the observer has simply been too lazy to take trouble to observe accurately? Yet that is in most cases all that has happened. The demonstration that the full moon on the horizon is no bigger than when it is high up in the sky, despite the very wide belief that in the former case it is much larger, is a model of explanation, but it is only one of the very many good things in this really excellent book.

England's Quest of Eastern Trade. By Sir WILLIAM FOSTER. (Black. 15*s.*).

There is no more romantic theme in history than that which Sir William Foster has made his own and which he sketches both authoritatively and attractively in his new volume. Our trade with the East was built up through generations by individual English enterprise. Merchants at home gave their money and advice; intrepid travellers surveyed the field and daring sea-captains undertook long voyages in their little vessels through uncharted seas, braving the elements and the hostility of European rivals as well as of Oriental despots. Many ships were wrecked, many traders and sailors lost their lives, many a voyage proved unprofitable, but still the quest continued until a great trade was built up and a firm footing in India was won.

English merchants had a two-fold aim. They wanted new markets for English cloth and they desired a share in the profitable traffic in spices and other Oriental goods. They did not at first know how best to reach the East. Sir Hugh Willoughby and Richard Chancellor in their initial venture of 1553 essayed the north-east passage round Asia to Cathay and, of course, failed. Willoughby perished in the Lapland winter, but Chancellor landed on the coast of the White Sea and founded a direct trade with Russia. Jenkinson in 1557 followed in Chancellor's track and passed on to Persia, but efforts to develop a Persian trade by this long overland route proved vain. The Levant Company, chartered in 1581, was more fortunate, and made Constantinople and Aleppo familiar to the Elizabethan public, but it could only form an indirect connexion with the markets of Asia. Some hopeful spirits believed in a north-west passage round America, but Frobisher, in 1576-8, while making important additions to the map, failed to traverse the Arctic. The only practicable route to the East was indicated by Drake's successful world voyage of 1577-80, and by Cavendish's similar voyage of 1586-88. John Newbery and Ralph Fitch, two London merchants, went through Turkey to the Persian Gulf and reached India, as prisoners of the Portuguese, in 1583. When Fitch returned in 1591, full of the wonders of India and Malaya, London merchants found courage to fit out three ships for a trial voyage direct to the East. Only the " Edward Bonaventure," under Captain James Lancaster, reached the Straits of Malacca in 1592, and on his way home Lancaster lost his ship and most of his crew in the West Indies, to which he had been driven by a series of misfortunes. But Lancaster's ill luck did not depress his supporters. They, with other merchants, proceeded to form the East India Company, chartered on the last day of 1600, and put Lancaster in charge of the first fleet which sailed for the Indies a few months later.

From this point onward our Eastern trade developed rapidly. Sir William Foster shows how overwhelming Dutch competition

soon ousted our merchants from the East Indies and forced them, fortunately, to concentrate their attention on the trade with India. Here, for a time, the Portuguese gave trouble, but the storming of their fort at Hormauz in 1622 by an Anglo-Persian force and an earlier sea-fight off Surat humbled them and raised the prestige of the English traders. From Surat in the west and Masulipatam in the east the Company's agents penetrated far into the interior and also opened up trade with the Red Sea and Persia. Sir Thomas Roe's famous mission to the Mogul Court in 1615-18 was not, on the whole, a success, but it helped the Company at a critical time. A brief summary of later events up to about 1660 brings this excellent book to an appropriate close. The dozen maps supplied will be useful to the reader.

My American Friends. By L. P. Jacks. (Constable. 6s.).

Professor Jacks first went to America in 1886 as a post-graduate to Harvard, a less usual experience then than it is to-day. He visited the country for the eighth time in 1931, and it is his recollections of that visit that form the basis of this book. America, he says, is the problem-hunter's paradise; but to say that the Americans enjoy their problems would be misleading, if not untrue. Like other visitors to that country, however, Professor Jacks found that the Americans enjoy discussing their problems, both those they have in common with the Old World and those that are peculiarly their own: "Nowhere else will you find this form of recreation so widely practised or so eagerly pursued." The author notes the intense suffering caused in America by the slump; but he notes also that the slump has furnished a feast of problems to those who are partial to that kind of entertainment, as Americans mostly are. In particular it has been a godsend to "the magicians, astrologers, soothsayers and Chaldeans—a numerous class in America which makes a business of predicting the future of the country."

Professor Jacks gives good advice to anyone who proposes to write a book about America. First, avoid generalizations ("all generalizations about America, except this one, are likely to be false.") Second, judge nothing in America at the point at which it has arrived; judge all things by the direction in which they are moving. Third, whenever the observer is struck by a feature which seems to him peculiarly good or peculiarly evil, let him at once look out for its contrary; he is sure to find it. The author visited forty-two of the states and in each he made his "American Friends." He writes of the cities and sidewalks; of the American intelligentsia, the Californians, and the Rhodes scholars; of standardization, children, education, recreation—and "some dark problems"; and of his search for the "hundred per cent American," whom he eventually discovered in an Arizona hotel in the person of Miss Susie Smith—"with manners as charming as her person."

Dr. Jacks found the Americans the most self-critical people on the face of the earth: "Along with a profound and exultant sense of achievement there goes, at least among the thoughtful, a sense of uncertainty as to what it is all worth, and even a lurking doubt as to whether it is worth anything. The American is often vociferous in these exultations and his vociferations sometimes give offence to foreigners. But if you hear him out to the end of his amazing story, you will find reason to suspect that vociferation is a means he adopts to stifle a doubt, even a dread, lest the whole fabric of achievement he has been describing should suddenly collapse and come to nothing."

Of the many topics on which Professor Jacks spoke in American cities, education always drew the largest and most eager audiences. Whatever may be said in disparagement of American education when judged by the standards of the Old World, there can be no doubt that the public interest in the subject and the public sense of its importance stand in America at a very high level. The author's impression is that education is one of the things that the American people believe in, aim at and are prepared to make sacrifices for. The millionaires have done much for the colleges, but as Dr. Jacks says, the colleges have also done much for the millionaires in giving them a rather different "attitude to life" from that connoted by the worship of the dollar. What he describes as the "give-and-take between the material and the spiritual" is a fact to be noted by those who study the relations between the money interest and the education of America: "The money has come out of the business, to be sure, and though most of its results in education flow back to the source from which the money came, there is generally a residue left over for the things of the spirit. A School of Business Administration placed in the midst of a university originally founded to promote the glory of God will get an occasional gleam of heavenly light from the contact, while the promoters of God's glory on their side may become reciprocally somewhat less unbusinesslike in the pursuit of their ideals. Such is the give-and-take."

Professor Jacks is an acute observer. He writes with understanding—and with a sense of humour. He has missed nothing, and his recollections, grave and gay, help the reader to a better understanding of a sometimes baffling people. If, as the author says, the Americans and the English cannot understand each other, what other two peoples can?

Modern Alchemy. By W. A. Noyes and W. A. Noyes, Jun. (Bailliere. 17s. 6d.).

By alchemy Dr. Noyes and his son, who are professors of chemistry in America, mean neither the romantic but erroneous conceptions of mediaeval alchemy—the Philosopher's Stone and the Elixir of Life—nor the modern swindling alchemy of the gentleman who diddles get-rich-quick syndicates with tales of making gold from lead. Their "philosopher's stone" is the whole body of knowledge of the atomic structure of the elements which modern physics has revealed to the inorganic chemist—knowledge which is far greater, as well as far more imaginative, than the wildest surmises of the Middle Ages. Their "elixir of life" is not, it is true, the compound which can keep mankind eternally young, but the less sensational, yet none the less useful thing, the results in organic chemistry and physiology, which have given man health of body and mind, which keep him alive in full vigour and render him immune from disease and from suffering. Round these themes the authors, without departing from the propriety, caution and accuracy which should characterise all good chemists, have written for the general reader an interesting book. They commence by surveying briefly various branches of science with a view to revealing their common characteristics. They then give an outline of modern ideas of the constitution of matter treating the subject matter of nuclear physics clearly and simply with the minimum of difficult conceptions. This leads to the remarkable work of the Cambridge school on the artificial transmutation of the light elements, which has been done since the War, and which, although quite useless practically, is a magnificent contribution both to experimental and theoretical science. The authors write also on subjects which have of late captivated the

Americans—valency and missing elements. They apply the inductive methods of organic chemistry to gain a better knowledge of the functions of electrons in chemical combinations. They write with first-hand knowledge of the recent discoveries of what once were " missing " elements which have been recently made in America, especially elements numbered 61 and 87. More generously than critically, however, they speak of element number 85 as being discovered by the Alabama workers. The evidence for this, however, is very poor, and certainly in Europe it is not accepted by any chemists of standing. Element 85, indeed, is now the only one of the 92 " theoretically " existing on our planet, which has failed to reveal itself.

The concluding chapters of the book are concerned with the great strides which organic chemistry has recently made in medical practice ; in immunity, with anaesthetics, in the relief of deficiency diseases by the ever increasing number of vitamins, and in the very difficult but most necessary work on hormones. The authors do not say, but they imply, that this part of modern science is only now emerging from its pre-natal sleep, and that the future will see great advances in every part of it with consequent relief to ill-health, fatigue, and suffering, as well as to more obvious forms of disease. The book is probably a little too discursive at times to be described as a model of popular exposition ; nevertheless it is good popular writing. The authors are perhaps too prone to be informative. They do not at times give their readers something hard to think of or difficult to bite into. They are to be commended for giving a critical bibliography at the end of each chapter so that any reader who would like to go further into the matters described may do so without difficulty. The book is well printed, suitably illustrated, well bound and not too long ; the price, perhaps, might be criticised as high, the more so when it is remembered that it has been written not for specialists but for general readers.

Birds from the Hide. By IAN M. THOMSON. (Black. 12*s*. 6*d*.).

The increase in bird photographers, and in the quality of their work during the last thirty years is remarkable. The pioneer efforts of the Kearton brothers have borne good fruit : now, every year, many bird books appear illustrated by photographs, and it is rarely that these fail to reach a high standard of excellence. This book contains sixty-three photogravures ; every one of them is good, both artistically and ornithologically.

In his preface Mr. Thomson modestly says he may have missed many things obvious to a first-class field naturalist. We do not think he has missed much ; he is evidently a careful observer as well as a photographer. For instance, in photographing Montagu's harriers he noticed the difference in the colour of the eye of year-old and mature birds. And he is alive to the varying individualities of members of the same species ; one pair of great crested grebes was so tame that the female not only refused to leave the nest when the author's boat approached, but screamed at and pecked him ; all the other pairs nesting on the same water were suspicious. Some bearded tits were not at all timid at the nest, but of other pairs sometimes the cock and sometimes the hen was the more easily alarmed. He noted that the hen bearded tit " combed " her nestlings' hair, *i.e.*, removed the loose skin from the sprouting feathers, and that the hen Montagu's harrier raised the level of her nest on a perfectly fine day, apparently in anticipation of the torrential rain which fell the next night. And he has heard the curlew on the nest crooning to her young like a farmyard hen.

Like most bird-lovers, Mr. Thomson has suffered at the hands of egg-collectors. The nest of a red-throated diver which he was photographing was stupidly robbed just before the one egg should have hatched ; he had hoped to photograph the nestling. He makes some pertinent remarks about indiscriminate protection. On one loch where all bird-life was unmolested the herring and black-backed gulls reduced other species almost to extinction. In some of the Shetlands the protection of skuas has wiped out the whimbrel and red-throated diver as nesting species ; the skuas take their eggs when well incubated. Protection is a difficult problem ; when once the balance of nature is disturbed it is not easy to restore it.

We have never seen finer bird photographs. That of the cock and hen Montagu's harriers at the nest is unique. All those of the bittern are interesting, especially that of the hen assimilating herself to the surrounding reeds when alarmed. The pictures of the red-throated diver, so graceful in the water and so clumsy out of it, and of the ridiculously tame phalarope deserve special mention, and we are glad that portraits of the commoner birds, such as lapwing, skylark and long-tailed tit are included. Were the large, brightly coloured bullfinches photographed, possibly the northern variety, *p. p. pyrrhula*, which breeds in northern Europe and is migratory ?

The Rome of the Early Church. By A. G. MACKINNON. (R.T.S. 7*s*. 6*d*.).

This is a remarkable book ; it will appeal to the student and to the general reader. Dr. Mackinnon has brought to the subject a refreshing breadth of mind and a wealth of imagination. His book is chiefly the story of Rome in the first century, and it gives us in vivid form the historic background of early Christianity. The dual conception of history is ably brought out. In the former our attention is focussed on events in the sphere of human activity—the clash of ideas, the march of movements, the rise and fall of nations, the evolution of civilization. But within and behind is the sovereignty of divine and directing purpose. Dr. Mackinnon emphasizes both sides in a striking manner, especially in his record of the spread of truth from Jerusalem to Rome and elsewhere. Upon occasion fancy is beautifully blended with fact, but the truth is never obscured ; it is always emphasized and exalted. The scene in the carpenter's shop at Nazareth is an illustration of this point.

The author asks, " Who first brought the gospel to Rome ? " and answers the question with a wealth of telling illustration : " The Priests made a great mistake when, in order to extinguish Christ, they handed Him over to the Roman authority and rejoiced to see Him a prisoner in the hands of the Roman soldiers. They were only thinking of the cruelty the latter might inflict upon him. They never dreamed of the influence the sufferer would have on the soldiers themselves, and that they were adopting the best method of spreading the knowledge of Jesus. They had unwittingly put their victim into touch with the best advertising agency, which would carry to the ends of the earth the knowledge of His life, death and resurrection. It was like placing the news in the front columns of our modern dailies. The barrack-room became a sounding-board, the transport a gospel-carrier, and the Roman eagle a herald that prepared the way." The book is rich in information concerning modern research and discovery. " Rome was once an arm of the sea." Dr. Mackinnon has an interesting story to tell of the way in which the sea receded and Rome was built. Whether one's interest is that of history, romance or religion, he will find abundant means for satisfaction in this book.

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